AGRICULTURAL ECONOMICS RESEARCH

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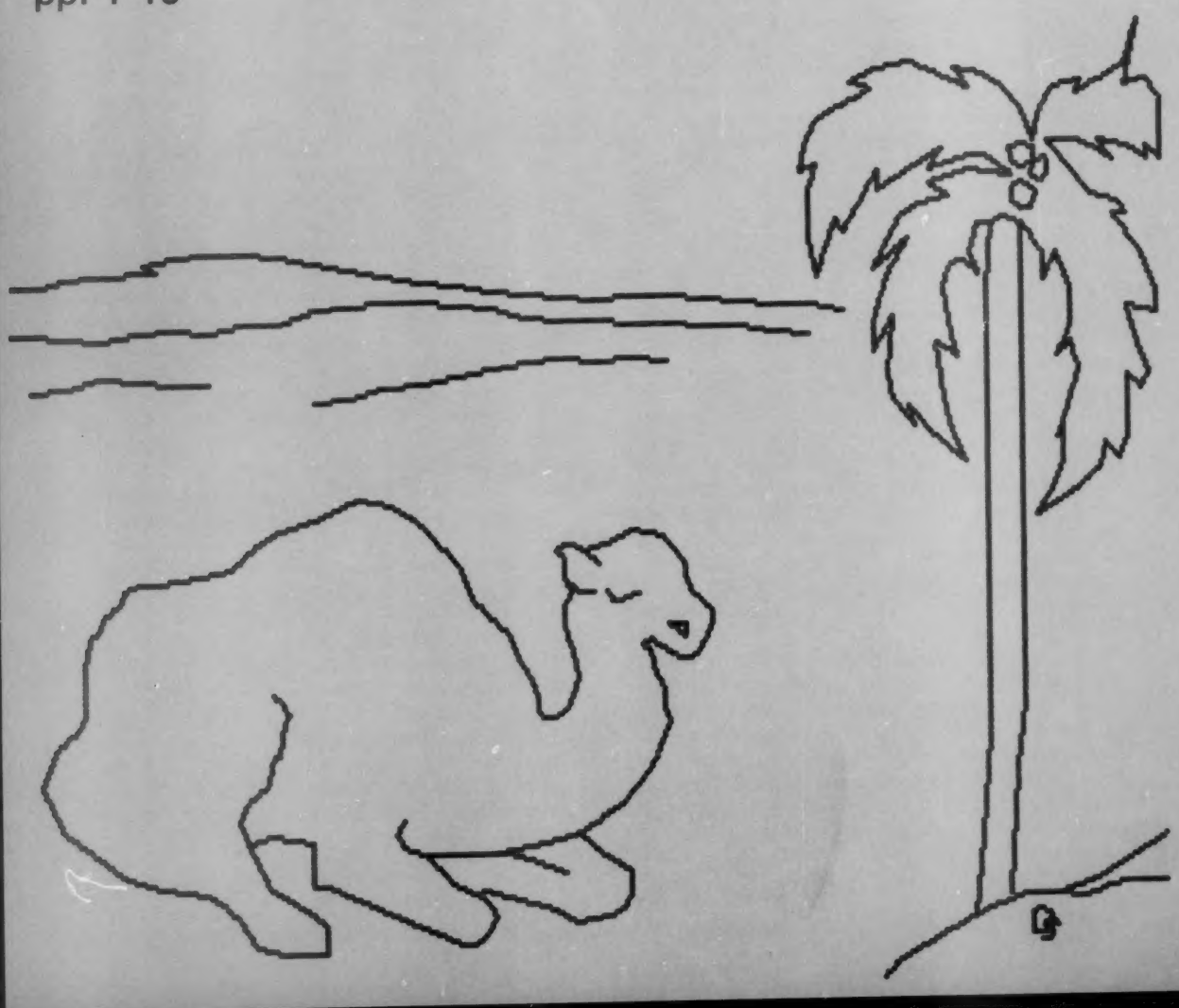
OASIS: an information system
pp. 1-19



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"The dry-as-dust soil of Upper Egypt yields . . . minute information regarding local methods of agriculture, manufacture, trade, and public administration," says Arnold Toynbee in Volume I of his *Study of History* as he expresses concern that historians have expended considerable energy studying the ancient Egyptian civilization simply because the data are there. We have pieced together relatively little information from scattered coins, inscriptions, and literary records on the contemporaneous civilization of the Seleucids in Asia. For nearly two centuries, the Seleucid Monarchy was, according to Toynbee, the greatest field of creative activity that existed in the world. The Egyptaic civilization was comparatively unfruitful. Owing, however, to a climatic accident, the amount of raw information on these two monarchies happens to be accessible to us in inverse ratio to their intrinsic importance in history. Scholars are forever prone, apparently, to study problems for which they have data instead of problems which are important.

This issue of *Agricultural Economics Research* focuses on computer-based data systems USDA economists use in their outlook and situation work. In these days of clever acronyms, the computer system for storing, retrieving, reporting, and analyzing data is called OASIS: *O*utlook *a*nd *S*ituation *I*nformation *S*ystem.

USDA is not the only Federal agency building computer-based data systems. The December 1976 issue of the *Statistical Reporter* contains an article called "User Access-Data Banks." The author points out that most agencies in the Federal Government which are engaged in extensive statistical work use electronic computers for this task.

This wide acceptance of electronic data processing equipment and the increasing demand for statistics for research and policy formation have resulted not only in a growing volume of statistics from these agencies, but also in a new storage medium, the machine-readable data file. Easy access to computerized data files, adds the author of the *Statistical Reporter* article, is essential for research, policy formulation, and publication. The article contains a description of the Bureau of Labor Statistics' machine-readable data bank, which includes the consumer and wholesale prices indexes and information on the labor force. Also mentioned are a listing entitled "Computer Tape/Files Available from the Bureau of the Census" and a National Technical Information Service "Directory of Computerized Data Files and Related Software." Other agencies with computerized data files include the Social Security Administration, National Center for Education Statistics, Law Enforcement Assistance Administration, and the National Archives and Records Service. Thus, USDA was not the first Federal agency to build a computerized data system, and it will not be the last.

The authors of the first article in this issue of the Journal describe the agricultural outlook and situation process in USDA, and they explain how a computer-based data retrieval and analysis system can improve the quality and quantity of reports. They also offer some interesting "behind-the-scenes" insights into task force behavior. The topic of an agricultural statistics data base was addressed in another issue of the *Statistical Reporter* (November 1977), and major users of these statistics were identified. The article is called "A Framework for Planning U.S. Federal Statistics, 1978-1989."

In the second article of the Journal, the writers explain how data are stored and how a generalized, user-oriented operating system makes it easy to produce reports or perform economic analyses. The third article consists of a set of four short notes chosen as examples of computerized data systems in USDA other than OASIS.

Let us hope that the right data are going into these several systems because, right or wrong, according to Toynbee's observation, these are the data USDA analysts will be using in their agricultural economics research. Toynbee concludes his observation on the tendency of the potter to become the slave of his clay with an analogy which points to a corrective. The successful industrialist, he notes, perceives a demand for a commodity and then lays his hands on the raw material which will meet that demand efficiently. In other words, the industrialist is a master of resources, not their slave.

CLARK EDWARDS

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On January 1, 1978, three USDA agencies—the Economic Research Service, the Statistical Reporting Service, and the Farmer Cooperative Service—merged into a new organization, the Economics, Statistics, and Cooperatives Service.

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OASIS – AN OVERVIEW*

- The assembly, processing, and dissemination of economic intelligence concerning agriculture is a complex process in which the U.S. Department of Agriculture and its subdivisions are greatly involved. The role of the Economics, Statistics, and Cooperatives Service in the information process is described and how recent enhancements in its internal information management help the agency to do a more effective job. The process of generating and disseminating forecasts and other economic information in ESCS is detailed. In addition, the motivation for improvements to the information system and the vehicle by which they were designed and implemented is presented.

- Keywords: Information management, forecasting, data bases, computers.

A major function of the Economics, Statistics, and Cooperatives Service (ESCS) is to provide economic intelligence on the agricultural sector to public and private decisionmakers. In this article, we describe the development of an effective, efficient process for analyzing and reporting this information—OASIS: Outlook and Situation Information System.

THE NEED FOR A COMPREHENSIVE SYSTEM

> **Behold, I set before you this day a blessing and a curse: the blessing, if ye shall hearken unto the commandments . . . which I command you this day; and the curse, if ye shall not hearken unto the commandments . . . but turn aside out of the way which I command you this day.**
> **Deuteronomy Ch. 11:26-28.**

While much of the operational structure needed already existed in ESCS, the information flow was fragmented before OASIS and no uniform format existed. This situation resulted, in part, because of the size and diversity of the staff and the distribution of functions in the food and fiber divisions. Further, conflicts occur between conducting basic research and performing such staff functions as special analyses, outlook and situation work, and providing current economic intelligence. Finally, no common research and information system with a strong data base existed through which researchers, analysts, and policymakers could interact.

Up to 1977, the Economic Research Service (ERS, now part of ESCS) had been establishing the roots of a strong, common research system and data base, but progress moved slowly because support was informal and vested in an ad hoc group of researchers, modelers, and computer specialists drawn together by common interests. Then, in 1977, a multitude of events in the agricultural sector intensified the demand for quick and comprehensive analysis. The existing system could not keep up with the flow of analysis and information required, and ERS Acting Administrator Kenneth Farrell formed the OASIS task force which began work in October 1977.

THE DEVELOPMENT OF OASIS

Formation of the Task Force

The makeup and operational license of the task force were somewhat unique. A number of ESCS staff members were selected, and were asked to work in a large room; they were charged (commanded) with analyzing and recommending a completely integrated, quick-turnaround information retrieval, analysis, and display system. They were relieved of their normal duties as much as possible so that they could attend the task force meetings. These were held in a different building from the members' office building to minimize distractions. The task force was established with no designated chairperson; no one was charged with maintaining order, or with keeping a cool head amidst the ensuing discussions.

Thus unconstrained, most of the members dredged up from the depths of their knowledge and/or biases, any points that they felt would have relevance to the task at hand. Members often emphasized their ideas by delivering them eyeball to eyeball at maximum volume: they uttered dire, prophetic warnings of bureaucratic retribution; hurled exquisite insults and heroic metaphors; used ways to attract attention or pose precise alternatives and ways to ease tension and cope with the objections of people who were not on the task force; and they knew when and where to adjourn at the end of a hard day. Despite the outward appearance of total chaos, it was a

*Thomas M. Bell is an economist, Audrey Lynne Loomis is a mathematician, and C. E. Overton is an agricultural economist with the Commodity Economics Division; Harper G. Grimm, Jr. is a systems analyst, and Raymond C. Schwartz and Juanita Tougias are computer programmers with Data Services Center; Stephen L. Magiera is an international economist, Jack Rower is an economist, and Martin W. Schwartz is a mathematician with the Foreign Demand and Competition Division; and Paul C. Westcott is an agricultural economist, and Joseph M. Roop, George E. St. George, and Michael A. Salant are economists with the National Economic Analysis Division. All authors are with ESCS.

Special acknowledgment goes to Martin W. Schwartz for coordinating preparation of this and the following article.

strikingly successful exercise in group dynamics. The task force produced a set of problem statements and recommendations and presented them to Agency management in late 1977 and early 1978.

Recommendations of the Task Force

The task force recommended that a computer-based system be developed which was capable of the quick turnaround necessary to support the outlook and situation process. In brief, the recommended system would consist of a well-maintained data base of historical and forecasted data, the software to effectively analyze and report this data, and a staff within a workable organizational arrangement.

The recommendations of the task force were accepted by the management team, and the task force was instructed to develop (1) an information presentation subsystem for displaying text, tables, and graphs, and (2) an improved data base and data maintenance procedures.

The starting point for OASIS proved to be the decision to combine Speakeasy, a user-oriented, interactive computer language, and T-DAM (Time-series Data Access Method), the ESCS/Economics time-series data management system. High-priority data for OASIS reports are currently maintained in T-DAM. The OASIS operating system is Speakeasy with a few additional routines.

THE FORECASTING PROCESS IN ESCS

> An expert is a person who avoids the small errors while sweeping on to the grand fallacy.
> —Weinberg's Corollary

Staffs of the three divisions in ESCS make economic forecasts, and each staff stresses a different aspect of the agricultural economy. Commodity, country, and aggregate analysts in these divisions have central forecasting responsibility. While aided by a variety of econometric models, they rely primarily on their own judgment. Activities of this large, diversified group must be coordinated during the forecasting process. Also, the three divisions often use a common set of variables; each division's assumptions and resulting forecasts must be checked with each of the other's for consistency. When an inconsistency is found, assumptions must be revised and a new forecast constructed. Many iterations of the entire process may be required. Thus, successful coordination and speed of consistency checks greatly affect quality and timeliness of the final Agency-wide forecast.

Foreign Demand and Competition Division

Analysis of domestic agriculture in a world context is essential for the policymaker. To meet this need, Foreign Demand and Competition Division (FDCD) analysts consider primarily the world economy and its relationship with the U.S. agricultural sector. Staff members provide country-specific forecasts for world production, consumption, and imports of the major grains, vegetable oils, and meals. These forecasts can be aggregated according to standard regional definitions and, once combined with the domestic outlook, a world perspective is attained for each commodity. The impact of changes abroad on U.S. export sales and the overall U.S. agricultural trade balance is also analyzed. As a result, stress situations, both shortages and surpluses, can be anticipated earlier than otherwise.

Commodity Economics Division

Commodity Economics Division (CED) analysts work with commodity-by-commodity detail within the domestic agricultural economy. The staff provides forecasts of supply, domestic use, stocks, and prices for the principal crop and livestock commodities. They consider the interrelationships between the feed and livestock sectors, other cross-commodity relationships, and Government policy variables and programs.

National Economic Analysis Division

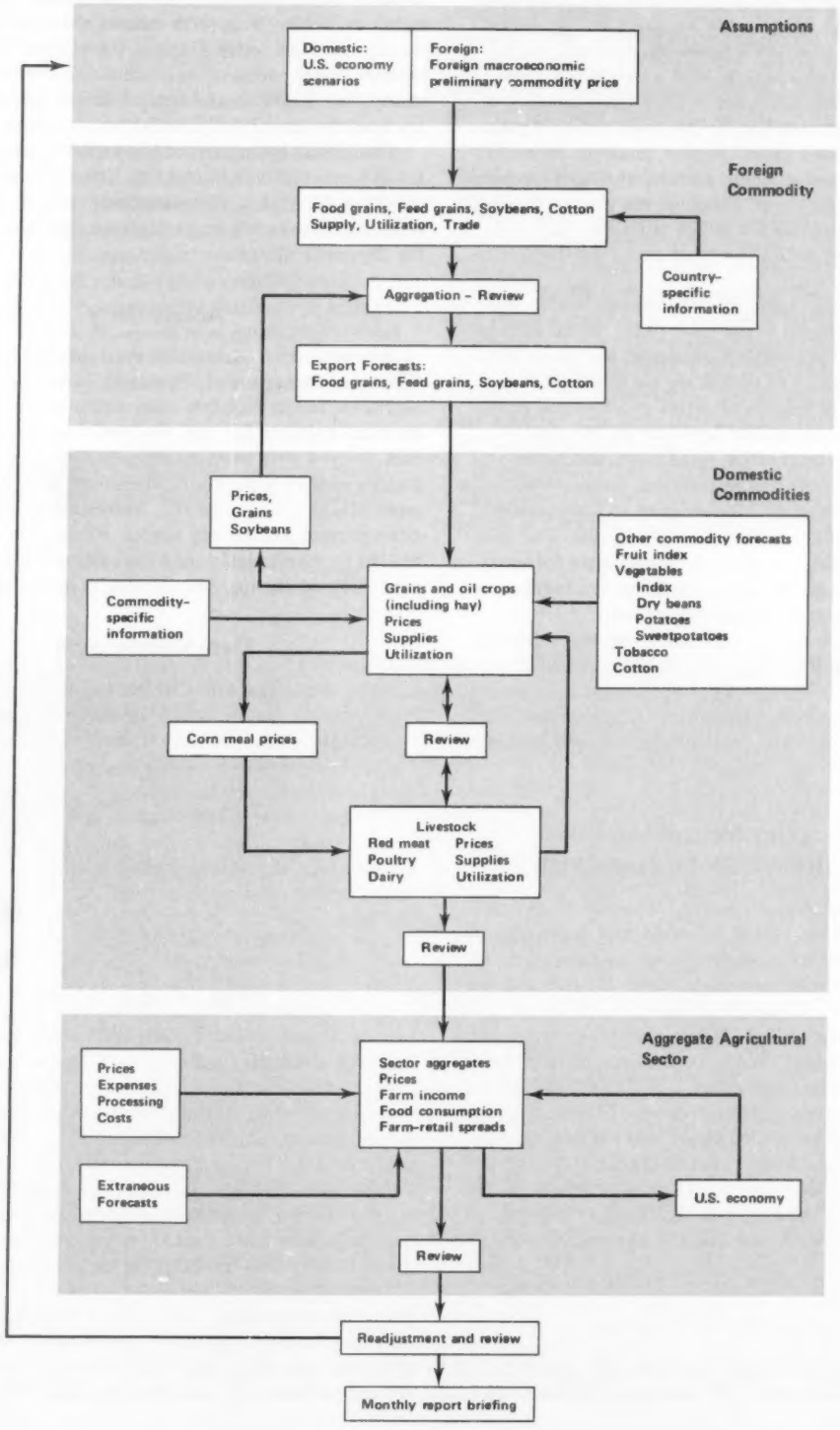
Measurements of the total or aggregate performance of the domestic agricultural economy provide a quick assessment of the health of the farm sector and also how other sectors, such as processors and consumers, are affected. The National Economics Analysis Division (NEAD) analyzes the relationship between the agricultural sector and the rest of the domestic economy. Farm income, farm prices received and paid, and the farm value of the market basket provide valuable information. Retail food prices, farm-to-retail market basket spreads, the marketing bill, and food consumption levels allow a quick appraisal of the agricultural situation from the farm to the consumer.

HOW THE PROCESS WORKS

The forecasting process begins with selected macroeconomic assumptions and preliminary commodity price forecasts (fig. 1). Next, FDCD country analysts forecast supply-utilization balances by country and commodity, and they aggregate these, according to standard regional defintions, to provide a preliminary world outlook for each commodity. Foreign commodity analysts and the FDCD outlook coordinator then review the results and reach a consensus on the U.S. export outlook.

Following these steps, key modelers and analysts from CED and FDCD meet together. FDCD analysts have the latest country-by-country information pertinent to the determination of U.S. exports, while CED analysts have data on the domestic side of the market.

FIGURE 1
Forecasting Process, ESCS, 1978



The two divisions' staffs establish a first-round equilibrium for each major domestic crop, and its relationship with the rest of the world.

As a second major part of the forecasting, CED staff members begin to analyze the livestock sector. Based on the grain and meal price forecasts, domestic supply and disposition information, and appropriate cross-commodity effects, CED and NEAD analysts reach a first-round equilibrium for the livestock and feed grain sectors. In a "round table" review, analysts check for compatibility between these sectors, and, if discrepancies exist, reconcile them. Forecasts are also prepared for the other commodities for which little simultaneous interaction occurs with the export-grains-livestock complex.

Forecasting the aggregate agricultural sector by NEAD analysts begins as the third phase. Items such as prices paid, farm production, expenses, and some retail prices are forecast. The results are combined and processed to yield indexes of prices received and paid, consumer price indexes and forecasts for the market basket statistics—farm value, retail costs, and farm-retail spreads. Supply and disposition, prices, exports, marketings, and loan activity are used to forecast cash receipts, from which farm income is forecast. The commodity and export data along with aggregate forecasts are used to forecast per capita consumption indexes and aggregate supply and utilization indexes.

The final phase of the forecasting process is devoted to reviewing the final forecasts, drafting reports and briefings, and integration of the process into the current dissemination vehicles—particularly, *Agricultural Outlook*, various outlook reports, and *Supply and Demand Estimates*.

AGENCY NEEDS IN INFORMATION MANAGEMENT

Economic intelligence useful for situation and outlook work must be current, accurate, and accessible. In addition, the information flow must be tailored to fit the organizational framework in which it exists and the requirements of information users.

The developers of T-DAM realized that program areas and other small ESCS units had to control read/write access to their data. Therefore, T-DAM data are divided into "logical groups". Because most of these program area data are more detailed than those needed for outlook and situation work, a central OASIS logical group was created to retain the data for this purpose. Little data duplication was involved. Similarly, OASIS logical groups were created to contain the analysts', model, and official forecasts.

Historical Data Series

Forecasting depends on historical data. Thus, OASIS contains many data series or variables, each with a particular function. As the OASIS task force was selecting and enhancing the operating and data base management systems, it was identifying and defining relevant data items in terms of output from the system. While the initial definition of system output contained approximately 600 data series, the task force found that other variables were necessary as it identified the required data manipulations. From the base of 600 output variables, the need for about 3,000 variables evolved.

The overall evaluation of the variables to be used in OASIS pointed immediately to three problem areas: selection of a basic file structure, the forecast and historical data series, and consistent data identification for the entire system.

Accessibility

Accessibility to data has several implications for information management. Foremost, information must be accessible for its multiple uses, which implies both that standard routines for data retrieval must exist, and also that derived data must be stored. Accessibility further implies easy identification. Therefore, standard naming conventions are mandatory. Accessibility also implies cost-efficient and timely access. Finally, data must be able to be manipulated, and the system must have the capability of storing derived results in the data bank.

Data Maintenance

Data must be current to be useful. Hence, means must exist to assure timely updating. Data must also be accurate; thus, verification procedures are necessary. In ESCS, commodity supply and utilization data are easily checked as each quarter and year must balance in the sense that supply equals use. Data are also verified easily if both annual and quarterly data are entered into the system independently; annual data are generally a sum or average of the quarterly numbers.

Data Types and Uses

A basic concept of T-DAM is that data be stored and retrieved in specific logical groups, frequencies, and time periods. For OASIS, the historical data (1960 to date) are maintained in logical groups named OSS. Because OASIS uses annual and quarterly data, T-DAM contains two historical logical groups for OASIS—OSSA for annual data and OSSQ for quarterly data.

The conceptual differences concerning annual and quarterly time frames create problems in the research areas. Commodity-oriented research staff most frequently view a year and its associated quarters in terms of a particular commodity and its marketing year. For example, the wheat year begins in June and ends in May of the next year. Thus, quarterly data for wheat are not defined in terms of standard calendar year quarters.

Analysts of the aggregate agricultural economy prefer data based on the standard calendar year because the quarterly and annual time periods correspond to those used to measure general economic movements.

USES OF OASIS

First and foremost, the purpose of OASIS is to provide information. After content, the most important aspect is the manner of presentation. OASIS contains an effective subsystem for displaying tabular, textual, and graphical information. Standard tables, graphs, and text can be intermixed with ad hoc displays in a multitude of formats to provide full-scale reports or briefs. Changes can be made at the last minute and a polished product will still be provided. Consequently, standard or highly tailored reports can be produced to support outlook and situation work as well as special analyses.

Forecasting

OASIS improves the overall ESCS forecasting procedure by providing better coordination and consistency checks.

Aggregation Routines

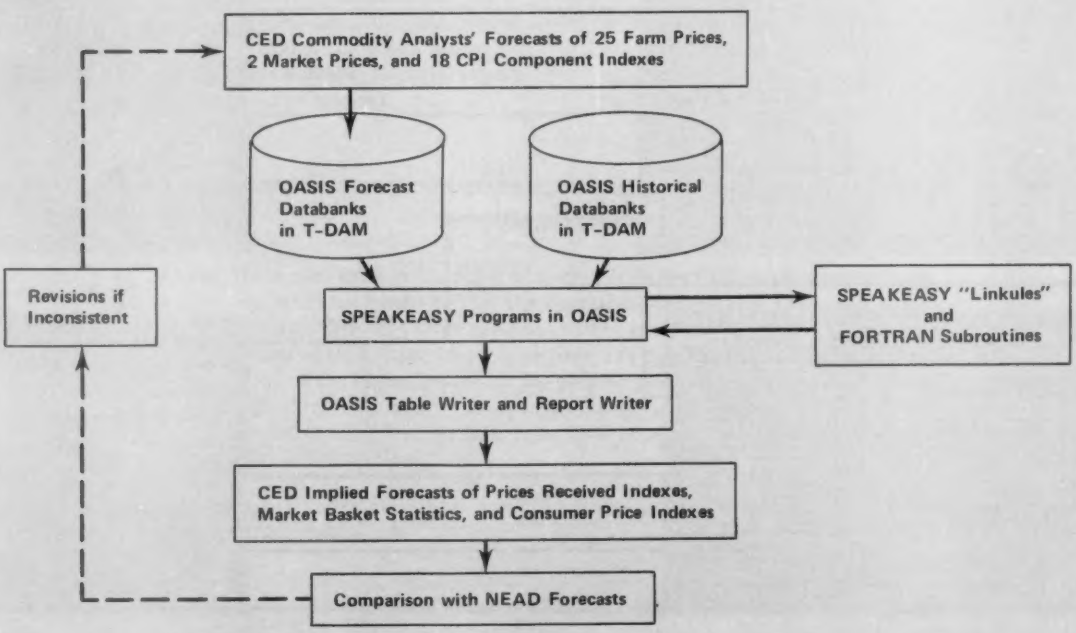
The outlook and situation process begins when FDCD analysts make trade forecasts. CED analysts make supply, utilization, and price forecasts for crop and livestock products. The price information is fed into OASIS, which constructs estimates for market basket items, farm prices received, and consumer price indexes. NEAD analysts use these forecasts (fig. 2).

The Farm Income Calculator

Information is also transferred from CED to NEAD to calculate the farm income. Besides CED forecast data, NEAD forecast data for some variables are also retrieved from the OASIS forecast databanks. The NEAD forecast data include marketing percentages and patterns, and Commodity Credit Corporation loan activity. This information is combined with CED price and production forecasts in the farm income calculator, which estimates both cash receipts from livestock and crop products and also overall farm income.

In this activity, the OASIS operating system coordinates the activities of more persons and, thus, more sources of data than in the aggregation routines, but the

FIGURE 2
Aggregation Routines


CED Commodity Analysts' Forecasts of 25 Farm Prices, 2 Market Prices, and 18 CPI Component Indexes
OASIS Forecast Databanks in T-DAM
OASIS Historical Databanks in T-DAM
Revisions if Inconsistent
SPEAKEASY Programs in OASIS
SPEAKEASY "Linkules" and FORTRAN Subroutines
OASIS Table Writer and Report Writer
CED Implied Forecasts of Prices Received Indexes, Market Basket Statistics, and Consumer Price Indexes
Comparison with NEAD Forecasts

structure is essentially the same. In both cases, analysts are quickly provided the means for making consistency checks on data from different sources.

Impact Analysis

The entire forecasting process in ESCS requires approximately 15 days to complete. On occasion, however, a much faster turnaround time is necessary. Throughout any given month, there is a continuous flow of new information related to the agricultural economy, and it may become necessary to reevaluate the current forecasts. In addition, ESCS economists are often called upon to answer questions related to changes in Government policy. Here, again, OASIS is useful. It will become more useful after the models proposed for use in short-run impact analysis have been incorporated.

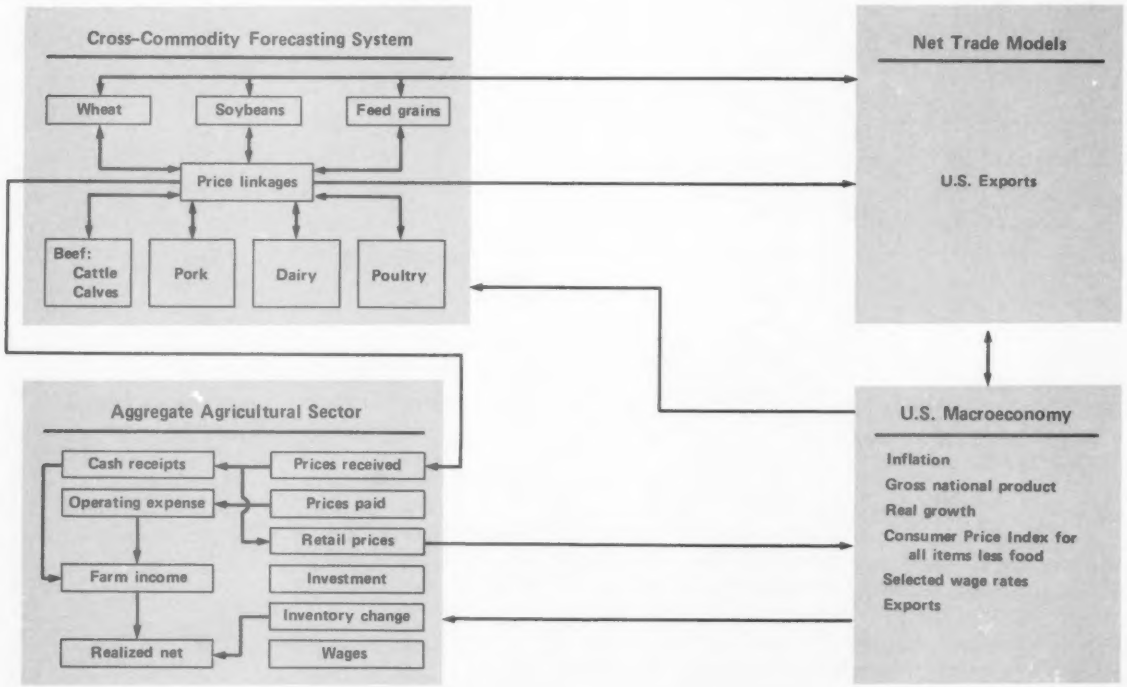
Although most changes in economic conditions or Government policies can be analysed through changes in a few key exogenous variables, the analysis will often cut across ESCS division lines. For example, analysts may be concerned with the impact on the consumer price index of a change emanating from a major international commodity market. Such a change might be the result of unforeseen shifts in economic conditions within that market or of new policy initiatives by a foreign government.

This type of impact analysis usually must be completed much faster than must the normal forecasts. To expedite this type of work, it has been recommended that a smaller group of ESCS staff be formed, to consist of the outlook and modeling coordinators and key policy and outlook analysts. Essentially, this group would respond to questions requiring quick turnaround and cutting across two or more divisions within ESCS.

Models

Such a staff would use three sets of short- to medium-term forecasting models currently housed in the divisions responsible for them. They pertain to world trade, domestic commodity markets, and U.S. aggregates. Figure 3 shows the required feedback mechanisms necessary to integrate these modeling systems. Some of the

FIGURE 3
Proposed Linkages Among Forecasting Models



integration problems have yet to be resolved. (See the April 1976 issue of this Journal for more information on these models.)

Additional work needs to be done to incorporate these models into OASIS and the models themselves need to be linked together. However, some of them are now available for use in forecasting and in impact analysis.

Use of Models

During the review process, the FDCD outlook coordinator and commodity analysts receive an alternative set of forecasts generated by the net trade models for wheat and coarse grains. These models take as exogenous the foreign production forecasts of the FDCD country analysts and the measures of macroeconomic activity abroad, and the models solve for a consistent set of trade forecasts. Because the models also generate price forecasts, there is an additional check on the accuracy of the preliminary commodity price assumptions. The models can therefore provide additional information useful for any iterative review process that occurs in or involves FDCD.

The process need not stop with FDCD, however. Suppose that a change in one of the net trade model's exogenous assumptions leads to a change in both the world demand for a commodity and also the U.S. exports of that commodity. One effect would be price changes in the cross commodity system and, eventually, a change in the consumer price index.

Once the models are integrated, the process can be carried further, and second-round effects can be analyzed. For example, a change in the consumer price index will affect the macroeconomy and, in turn, U.S. agriculture and trade. These second-round effects would thus work their way back through the entire model system. Once an equilibrium is attained, the total impact of the exogenous change could be assessed.

CONCLUSIONS

The first 90 percent of the task takes 90 percent of the time, and the last 10 percent takes the other 90 percent.[1]
—The 90-90 Rule of Project Schedules

This description of the need for and development of OASIS and of the ESCS forecasting system demonstrates both OASIS' usefulness now and greater usefulness later as new capabilities such as the ESCS forecasting models are incorporated into OASIS. It provides the nonexpert user with comprehensive up-to-date, reliable information. Data can be readily retrieved, for use in calculations, equation estimation, and model simulation.

The software design allows inexperienced users to produce readable tables, graphs, and text output in standard formats. The system tolerates errors in the sense that mistakes rarely destroy previous work. Because it will provide instructions when queried, OASIS acts partly as a teaching machine to its users.

The flow of information between the analysts and modelers and among the three ESCS divisions occurs through OASIS data banks. The banks function as an assembly line, storing the partially assembled reports between the various operations.

Currently, the small OASIS staff has two functions: maintenance of the data banks and development of computer systems. Only the first phase has been completed.

OASIS includes not only the data on major domestic commodities, foreign production, U.S. and foreign trade, and aggregate agricultural indicators, but also means of assessing and weighing the interactions between the U.S. and foreign agricultural sectors, between the various agricultural commodities, and between the agricultural and nonagricultural sectors of the domestic economy.

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[1] Totals may not add due to rounding.

Note: For references, see end of next article.

In Earlier Issues

"Among those who work in the fields of social psychology and applied psychology, the research on attitudes conducted by the Bureau of Agricultural Economics is well known. This research falls into three periods. . . . The three periods reflect the nature of the basic problems of their times—depression, war, and now the threat of agricultural surpluses . . . One of the major features of the present program of analysis of consumer preferences is its direction toward classes of products rather than toward specific brands . . . The outstanding findings have been those showing the importance of quality (instead of) price considerations."

James A. Bayton
Vol. 2, No. 4, Oct. 1950
pp. 105 & 111

OASIS–A CLOSER LOOK*

- The design and implementation of a computer-based information system for research and for outlook and situation processsing within the Economics Statistics, and Cooperatives Service uncovered many critical areas: user orientation, data management, analytical capability, and clarity of output. Many computer-related design criteria were considered, such as free-format vocabulary, extendability, linkage to different data and program storage devices, and error detection-correction capabilities. Data storage and manipulation techniques were emphasized since these form a vital part of the outlook and situation process. The resulting system is one in which the casual or novice user can communicate a problem to the computer in a natural manner with little knowledge about programming or internal workings of the computer.

- Keywords: Information management, data bases, programming languages, computers, research support systems.

Rapid, accurate, and easy flow of information within the Economics, Statistics, and Cooperatives Service (ESCS) depends on a computer system. As authors of the first article in this issue we described the need for and development of the computerized outlook and situation Information system (OASIS), and we explained its use within the ESCS forecasting process. In this article, we present a more detailed description of OASIS. Because it is important to understand the philosophy behind OASIS, we will examine the criteria for the system, as well as its capabilities.[1]

*Thomas M. Bell is an economist, Audrey Lynne Loomis is a mathematician, and C. E. Overton is an agricultural economist with the Commodity Economics Division; Harper G. Grimm, Jr. is a systems analyst, and Raymond C. Schwartz and Juanita Tougias are computer programmers with Data Services Center; Stephen L. Magiera is an international economist, Jack Rower is an economist, and Martin W. Schwartz is a mathematician with the Foreign Demand and Competition Division; and Paul C. Westcott is an agricultural economist, and Joseph M. Roop, George E. St. George, and Michael A. Salant are economists with the National Economic Analysis Division. All authors are with ESCS.

Special acknowledgment goes to Martin W. Schwartz for coordinating preparation of this and the previous article.

[1] The description of the system represents only its highlights. Additional documentation is available from the OASIS office in ESCS and from the Speakeasy Center at Argonne National Laboratory. See also the references at the end of the article. The system, including software and data base, is currently available only to USDA employees located in Washington. Others can, however, obtain the software by joining the Speakeasy Users Group (contact the Speakeasy Center) and they can obtain the historical data base from ESCS.

THE PURPOSE FOR OASIS

The basic reason OASIS exists is to enable its users to store, manipulate, and display information as desired with a minimum of effort and wasted time. Within ESCS, however, a substantial amount of research and analysis is used in the outlook and situation process. Thus, the OASIS task force recognized the benefits of a system that would support both research and forecasting activities. With such a system, the end result, the report, would emerge as a natural result of the underlying analysis. While most of the phase one implementation of OASIS involved data management and display components, the marriage of the analysis and research components to them was kept in mind, especially in selecting an operating system.

More specifically, the long-range OASIS goals are: (1) to provide an effective time-series data management system for outlook and situation and research activities; (2) to assist in an integrated, comprehensive flow of information within ESCS; (3) to increase the stock of user-oriented tools; and (4) to provide a central focus for the agency's outlook and situation modeling efforts.

CHOOSING/DESIGNING THE OPERATING SYSTEM

> **Build a system that even a fool can use, and only a fool will want to use it.**
> **—Shaw's Principle**

The basic criterion for OASIS was that it be an interactive, well-documented, user-oriented system capable of providing results quickly. The following additional criteria were also important.

Additional Criteria

OASIS must also operate in a "batch" environment so that large or low-priority requirements can be filled at lower dollar costs. The same commands and syntax should be used in both interactive and "batch" modes.

The system should incorporate facilities for the retrieval of variables with different structures (such as scalars one- and two-dimensional arrays of numbers and literals) into a temporary workspace, the manipulation of these objects, and storage of the results.

The vocabulary should be "free-format" and extendable through standard programming to accomplish additional tasks. Some mechanism for the creation of "pro-

grams" of the system's vocabulary should be provided to help with recurring or iterative tasks, and some method should exist for storing and retrieving these "programs".

Individual users should be able to maintain their own libraries of temporary data, program, and vocabulary extensions, so, they can keep their own materials without affecting either the performance or the cost for other users.

Design Alternatives

The OASIS task force had several alternatives available. Excellent software for the individual pieces of the overall computer system exist; there are data base management systems, statistical packages, linear programming systems, and the like, which satisfy very demanding people. But they satisfy only a small part of the requirements for OASIS. The task force could have chosen one system to satisfy the numerical information communication needs, another to satisfy the text communication, a third for econometric modeling, a fourth for linear programming modeling, and so forth, and it could have tried to merge them together.

Ad hoc merging was rejected for several reasons, First, it was felt that an integrated system would serve not only to link the various parts, but as a basis for common communication among users. Second, the time available for the task force to complete the work was very short. Finally, a system that already met several of the needs would allow concentration on only those pieces that were weak or missing.

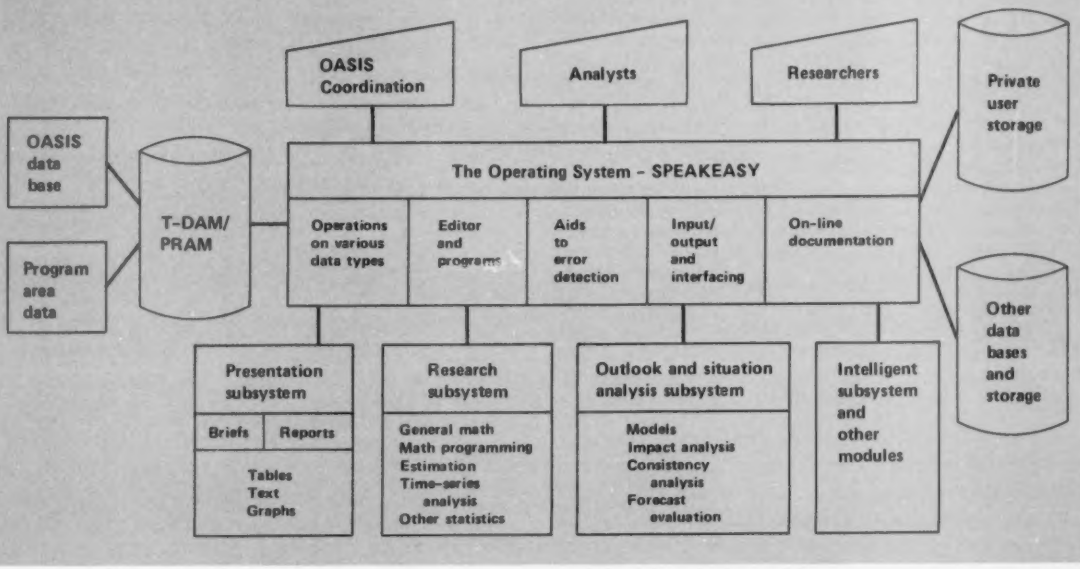
Selection of Speakeasy

A system already in use within ESCS was chosen because it met more of the criteria than any other: Speakeasy. Originally designed as a tool for researchers in the physical sciences, Speakeasy has been used more and more in the social science community. The Federal Reserve Board added many econometric routines to the system for its research staff. There are more accesses to Fedeasy, the Federal Reserve version, than to any other system including compilers and utilities. As Speakeasy was already being used in ESCS, it had the advantage of familiarity. In addition it already had a modular connection to a time series data management system and some tabular and graphics capabilities. The key factor, however, was that the Speakeasy processor is designed so that extensions to its capabilities can be made in a standard, yet flexible manner.

Adding some information communication modules and improving others gave the OASIS task force a way to develop a system with a much broader range of capabilities than any other publicly available package and to make this system operational within the very severe time constraints imposed by ESCS needs.

The most important reason for choosing Speakeasy is

FIGURE 1
The OASIS Computer System



its basic design. The system's designers realized from the start that attempting to build into a single processor as many capabilities as Speakeasy contains would result in a hopelessly complex package. Instead, they built a processor with only a limited set of operations and added to these operations with a network of attached libraries. In other words, Speakeasy is a modular system. The processor and the libraries are separate. Users can add, and have added, their own libraries. These libraries are all independent; their inclusion or removal does not affect the integrity of the processor. The additions for OASIS increase the power of the system, but they do not interfere with existing capabilities of Speakeasy.

THE OPERATING SYSTEM

A graphic version of OASIS is shown in figure 1. The function of the operating system, at the center of the computer system, is to provide effective applications control. The user retrieves data from the data bases and navigates it through assorted analyses into display or storage for further use. Table 1 shows some of the capabilities. Their extremely broad range makes it difficult to categorize or list them effectively in the limited available space. Those wishing more detail should contact the Speakeasy Center.

DATA MANAGEMENT AND DATA BASES

A relevant, well-maintained data base is, of course, essential for outlook and situation work. Data management is necessary to assure the integrity of the data and to provide for timely updating and a consistent variable nomenclature. Rapid data access, though, is only one condition for complete data support. Thus, a program of thorough, careful data updating and maintenance is also needed to assure both quality and timeliness.

In addition to the primary OASIS data base, users need access to other data. Detailed data maintained by other ESCS/ECON units, ESCS/STAT units, other USDA agencies, and other outside sources are all helpful

Table 1—Capabilities of the operating system, OASIS

Data types	Real or complex numbers Character or name literals Scalars One- and two-dimensional arrays Vectors Matrices Sets
Function types	Element-by-element functions Sums and products of elements Structural information and transformation Functions of one-dimensional arrays Matrix algebra Set algebra Statistical functions Logical functions
Editor and programs	Editor similar to IBM TSO editor WHOOPS command to reverse effect of last change made by editor Loops, branches, and user prompts in programs Programs may be entered at any statement label
Aids to error detection	Automatic printing of selected variables Logical traces Selected output if error occurs Execution of specified statement if error occurs Branching control if error occurs Pause after given number of steps Correct ■ program during execution
Fortran input/output and interfacing	Formatted and unformatted Fortran read, write, and punch Call Fortran function or subroutine Read SPSS save files Fortran and PL/1 programs can read/write data to user libraries
On-line documentation	Help documents for each command Examples of many commands Tutorials on system use

for outlook work and they are sometimes necessary for research.[2] Thus, OASIS must be linked to other data management systems. In addition, individual users also need to be able to store their own programs and data. OASIS currently provides facilities to maintain its central data base, to access any other from T-DAM (Time-Series Data Access method), to access data in some commercial data management systems, read and write character image files, and to maintain private libraries for users.

T-DAM

T-DAM is the data management system used for the OASIS data base. It is specifically designed for economic time-series data. In 1976, development began on T-DAM because there was no efficient time-series data management system available to the former Economic Research Service.

T-DAM can contain any number of variables, and it has 50 million observations. Variables are divided into logical groups (each group has a 3-character name and belongs to a specific user or project), plus a 20-character variable name (though OASIS allows only 7 characters for Speakeasy use). OASIS data currently make up about 10 percent of the total data available in T-DAM.

While all OASIS users can read almost all T-DAM data, a logical group's owner can restrict even the reading of his data to specific persons. Users can create new variables and update existing variables only within logical groups that they own. Both password-protection and use-auditing systems are included in T-DAM.

T-DAM allows various periodicities, and the user may specify the beginning and ending periods. All retrievals may be started at the same time period, and the retrieved results will be padded; that is, equivalent dates are alined in columns.

Other salient features of T-DAM appear in table 2. PRAM (Page Relative Access Method) is a recently developed enhancement which improves both space management and user performance.

Table 2—Features of T-DAM-PRAM, data management system used in ESCS

Feature
Ability to interface to any user's program via a "standardized" subroutine call
Almost unlimited amount of data on-line at one time
Data series logically divided into "logical groups", but in one centralized physical file
System operable in both interactive and batch modes
Data access protected so only the owner of a "logical group" (or someone he specifies) can alter his data, and so the owner can restrict even the reading of his data when desired
Completely mnemonic names for the data variables
Capability for maintaining documentation information, such as units of measure, source, description, owner, last updater, and date last updated for each variable
Flexibility of internal data formats, including INTEGER, REAL, and DOUBLE-PRECISION
Automatic handling of periodicities such as annual, quarterly, and monthly
Space-accounting facility which reclaims space from deleted variables, facilitates addition of new observations to an existing variable, and allows each variable to have an almost unlimited number of observations
Retrieval of any desired contiguous subset of possible observations
Auditing facility to log who (which user) is doing what to which data; can be valuable in tracking system or user problems and in supplying management information
Archive facility for holding logical groups of variables not currently required on-line (to reduce on-line disk costs), and to be a system backup
Linkes to various software packages, such as SAS, SPSS, TPL

Other Data Bases and Data Management Packages

As the operating system permits Fortran subroutine calls, it is relatively easy to interface OASIS with any commercially available, or user-developed data management package which has a Fortran interface. Some packages for which interfaces have been developed include Total, Ramis, Starmap, SPSS, and the Federal Reserve's MDL. The Fortran input-output capabilities allow interfacing (with some decrease in efficiency) with any data set or data management package formatted in either character image or Fortran unformatted format.

Private Storage for Users

OASIS provides users the ability to store data or programs using standard Speakeasy facilities. These include "mykeep" libraries, partitioned data sets whose members are read and stored with standard calls, a checkpoint facility, and a test version of generic and relational data bases.

The OASIS Data Base

If OASIS does not survive as a system that provides information to policymakers, the reason will be that the OASIS data base is not properly maintained. No information system will succeed unless its data are updated consistently, completely, and promptly. Therefore, the

[2] ESCS/ECON refers to the former Economic Research Service, and ESCS/STAT to the former Statistical Reporting Service. Both are now parts of the Economics, Statistics, and Cooperatives Service formed January 1, 1978.

OASIS task force spent considerable time determining the types of data in the data base, how they should be maintained, and by whom.

Hot data are those with major impacts on commodity markets, farm income, policy decisions, and so on. They are typically released in automated or routine published form, but their sensitivity means that they must be captured immediately and entered into the system quickly.

Automated data are those received on computer tape or other machine-readable form. One primary source may have data of interest to several program areas in ESCS divisions. Centralized collection and entry of such data is more efficient than allowing each interested group to collect the data.

Routine published data are periodically published in nonautomated form. Hot data may be included, but usually the publication will contain considerably more than this type of data. When a large number of variables are collected from a single publication, updates are best managed by keying in the data from published form directly into the data bank. Because the published data typically have a standard format, programs to prompt the terminal operator for the data are ideal. When only a few variables are involved, the data are best treated as routine and unpublished.

Routine unpublished data are routinely collected, but through means other than in automated or published form. Data acquired by telephone from other agencies represent an example. Ideally they should be entered on a standard form which can be keyed into the data base.

Derived data come from other data either by quantifiable or subjective procedures. The first type may be automated; the second may not. Finally textual information generated within ESCS for use in briefs must be entered into OASIS, and such text must be treated as hot data.

THE OASIS PRESENTATION SUBSYSTEM

> An ounce of image is worth a pound of performance
>
> —Peter's Placebo

The information presentation facilities were designed to have a set of commands for creating and maintaining table, text, and graphics units. Further, these units were to be merged into user-oriented products known as BRIEFs and REPORTs. The T-DAM data management system interacts with these BRIEFs and REPORTs so that data required for tables and graphs can be automatically retrieved for use.

Tables

Speakeasy offers a tabulate command which produces tabular listings of data. While this command is flexible, it does not offer such required features as footnotes, easy dating of periodicities, and multiple labels per data line. Therefore, a series of commands were set up to allow creation, alteration, and printing of table specifications. Clerical and research staff with no computer background have learned to create table specifications within a few hours. Tables are designed to be generated from within REPORTs and BRIEFs. They require a specific environment which is created by the commands REPORT, BRIEF, and SHOWTABLE. A typical table is shown as table 3.

Text

Textual material is required to explain "hard data" presented in tables and graphs. Therefore, OASIS needed facilities for creating, editing, and printing textual information. Speakeasy provides some textual facilities. It was determined that judicious use of these commands within a Speakeasy program would provide the basic facilities required for OASIS' initial operation. However, four new commands were added. Figure 2 shows a BRIEF, including text and a TABULATE table.

Graphics

Graphical displays are a highly convenient way of conveying economic information. An integral part of OASIS, they have two levels of implementation. The first level was developed at Communications Satellite Corporation and is supplied with Speakeasy. The second level is created by combining the first-level graphics commands with other Speakeasy commands into linkule-driven prompting programs. Both levels have unique advantages and limitations.

The graphics package as supplied with Speakeasy is designed to support many different terminal types. Others can be added by the installation without undue difficulty. The main feature is that all of the graphics commands are the same for all terminal types; thus, users need learn only one set of graphics commands.

While the standard graphics commands provide easily understood methods for generating tailored graphical output, however, users identified three needs that dictated the second level of graphics capabilities. First, policymakers often must have graphics quickly. These requests cannot be planned; frequently, they must be completed within 1 or 2 working days. Second, standard graphs are needed that can be easily reproduced following updates of the data series. Many ESCS program areas keep files of such graphs for a large volume of data, some of which are updated monthly. Third, many graphs are needed only once, either as an analytical aid or for a briefing. Often, the user drew such graphs by hand.

The OASIS task force had to provide for these needs in a comprehensive yet user-oriented manner, one that could adapt to users' different requirements. In any system adopted, updates had to be handled easily. Also,

Figure 2

Commodity Highlights

January 28, 1978

Crop and livestock production were large in 1977 and production will remain large in 1978. Plentiful supplies of feed are helping to encourage a continuation of the expansion in livestock and poultry feeding. This will boost meat output in 1978, even though slaughter of cattle coming off pastures and ranges likely will be down. And if crop farmers carry out their plans stated in recent planning intentions report, crop output will be large again this year, providing weather conditions aren't too bad.

Farmers have said that acreage planted to major crops may decline about 2 percent from 1977, with most of the avreage decline in wheat and cotton. Larger plantings for soybeans were partly offsetting. The indicated small reductions in plantings of feed grains suggest that few farmers are responding to the conditional set-aside feed grain program. Of course, farmers still have ample opportunity to adjust planting decisions in response to changes in price relationships among crops, the availability and costs of inputs, the final decision on whether a feed grain set-aside program will be available for 1978 crops, and the level of price support for soybeans. Also, weather is always an uncertain factor to be considered in planting decisions. These and the recent unrest among farmers make the planting intentions even more tentative than usual this year.

However, with recent widespread improvements in moisture conditions in the United States and generally good conditions abroad, prospective plantings would suggest U.S. crops of corn and soybeans could exceed likely utilization during 1978/79. If the wheat crop were reduced about in line with plantings, production may run a little below utilization.

Plantings of Major Crops (Millions of Acres)

CROP	CROPYR76	CROPYR77	PLANND78	PCTCHG78
Corn	84.4	82.7	80.9	-2.1
Sorghum	18.4	17	17.5	3.2
Barley	9.2	10.6	10.6	-.3
Oats	16.7	17.8	17.6	-1.2
Feed Grains	128.7	128.1	126.6	-1.2
Durum wheat	4.7	3.2	4.2	31.2
Other spring wheat	17.8	15.6	13.7	-12.2
Total spring wheat	22.5	18.8	17.9	-4.8
Winter wheat	57.7	56	48.1	-14
Total wheat	80.2	74.8	66	-11.8
Soybeans	50.2	59.1	63.9	8.2
Upland cotton	11.6	13.6	12.6	-7.3
Flaxseed	1.1	1.5	1.3	-15.6
Sugarbeets	1.5	1.3	1.3	4.5
Rye	2.7	2.7	2.9	7.8
Rice	2.5	2.3	2.5	9.8
Total	278.5	283.4	277.1	-2.2

U. S. DEPARTMENT OF AGRICULTURE
ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE
OUTLOOK AND SITUATION INFORMATION SYSTEM

TABLE 3.--WORLD GRAIN PRODUCTION BY CROP AND MAJOR PRODUCING REGION

ID:	VARIABLE NAME	UNITS	1973 HISTORY	1974 HISTORY	1975 HISTORY	1976 HISTORY
1:	WHEAT (TOTAL)	1000 M.T.	372,005:	356,141:	349,198:	415,528
2:	U.S.		46,560:	48,496:	57,751:	58,296
3:	CANADA		16,159:	13,295:	17,078:	23,587
4:	ARGENTINA		6,560:	5,970:	8,570:	11,000
5:	USSR		109,784:	83,913:	66,224:	96,882
6:	EEC-9		41,393:	45,391:	38,105:	39,539
7:	OTH.W. EUROPE		9,372:	11,305:	10,397:	11,561
8:	E. EUROPE		31,631:	34,107:	28,485:	34,614
9:	AUSTRALIA		11,987:	11,357:	11,982:	11,713
10:	COARSE GRAINS	1000 M.T.	661,178:	621,536:	635,406:	693,875
11:	U.S.		186,777:	150,905:	185,057:	193,859
12:	ARGENTINA		17,935:	13,793:	12,438:	16,860
13:	CANADA		20,411:	17,436:	19,987:	21,125
14:	AUSTRALIA		24,976:	21,968:	20,702:	16,543
15:	BRAZIL		16,851:	16,926:	18,482:	19,381
16:	THAILAND		2,520:	2,730:	3,350:	3,000
17:	USSR		100,951:	99,744:	65,820:	114,979
18:	RICE ROUGH	1000 M.T.	223,469:	227,339:	243,109:	235,402
19:	U.S.		3,034:	3,667:	4,091:	3,777
20:	THAILAND		9,471:	9,570:	10,032:	10,428

many potential users of the new system did not have time to write and "debug" a level-one program whenever they needed a complex graph; thus, OASIS had to be able to meet their needs.

The solution was to install in the OASIS system a second graphics level consisting of linkule-driven Speakeasy programs which prompt the user for the appropriate parameters needed to create a graph and produce the desired graph with a single command. The graphics are also designed so that they can be driven by the REPORT and BRIEF commands.

This graphics facility has already demonstrated its worth, as it is quick and easy to use. While being developed, it was used to meet needs of Department and agency level policymakers. Production of a single graph takes about 10 minutes, specification and production included. Because little or no programming is involved, and on-line instructions are available for every portion of the OASIS system, the uninitiated can easily produce useful results in a short time. Several improvements will be made to the graphics at both levels, and the system will be able to provide more varied types of graphics. Figure 3 shows an OASIS graph.

BRIEFS

A BRIEF is a self-contained set of materials not alterable by the final user. It covers specific time periods and data, and it is produced for a specific purpose—generally to describe a current situation or to respond to a specific question.

OASIS briefs are designed to provide information to users who have a minimum knowledge of computer systems. While a report requires the user to specify time periods and some other optional information, a brief is completely self-contained. After typing "BRIEF(name1

name2 . . .)", the user receives briefings on the named subjects.

An extension of the briefing facility is the "time-stamped" briefing. Each BRIEF is recorded in a table with the date and time of its storage. Another table is kept in OASIS showing the last date and time that an authorized recipient of briefs received an updated listing of available briefs. When such a user types the OASIS command BRIEFME, an index of new or altered briefs is produced. After seeing this, the user can ask for a print-out of all indexed briefs or terminate the automatic briefing and, using the BRIEF command, request only certain briefs. At this time, the user's profile is altered to reflect that he or she is up to date.

Reports

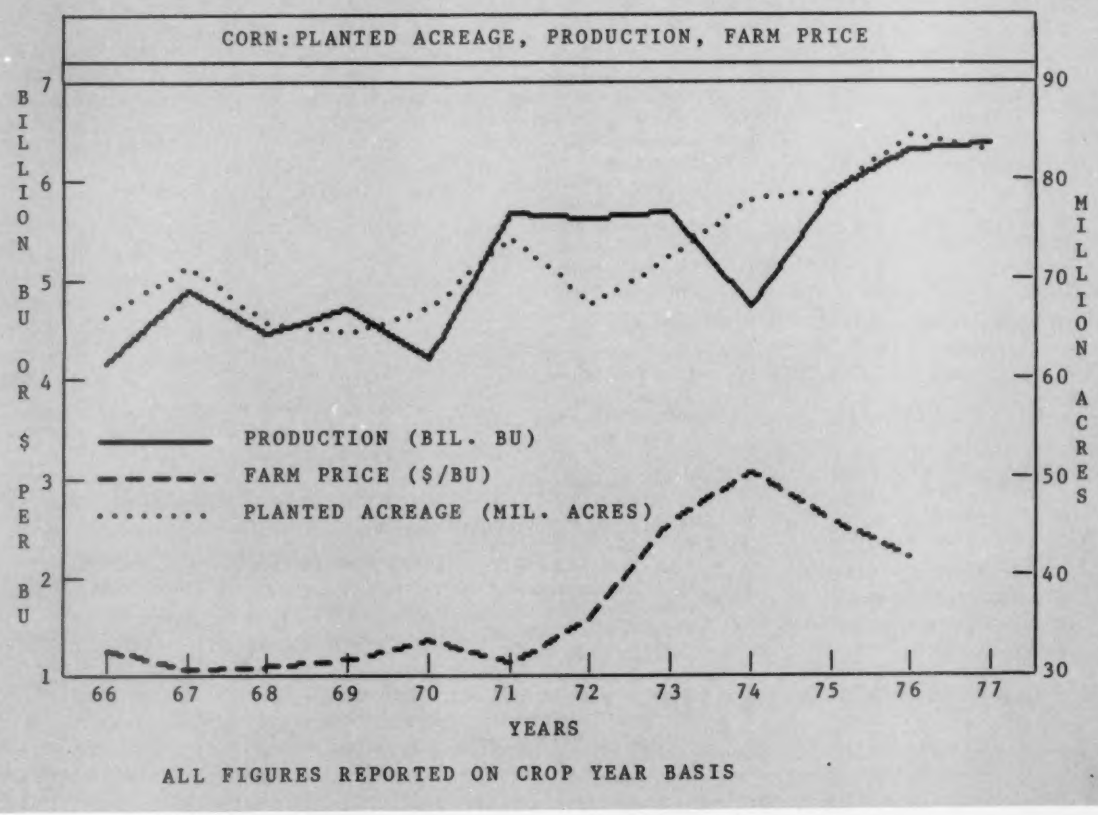
OASIS reports are predefined combinations of one or more tables, graphs, and text units. The time periods, forecast scenarios, periodicities, and some other environmental attributes are specified at the time the report is requested, allowing flexibility in displaying tables and graphs in response to ad hoc needs of researchers or analysts.

Technically, the REPORT command retrieves each requested report specification and writes its individual lines into one sequential file. The computer sets the environment based upon the parameters included with the REPORT command, and it shifts the control input from the terminal (or card reader) to that file of control cards.

THE GENERAL RESEARCH SUBSYSTEM

All of the general capabilities described above are useful in economic research. But Speakeasy users have been especially active in the areas of statistics and economics.

FIGURE 3
An OASIS Graph



OASIS contains probably the best system which is publically available for economics research. Other systems may be superior in one aspect, but none have the flexibility or the breadth of the Speakeasy/Fedeasy/OASIS system. Table 4 outlines some of the capabilities developed at various places: the Speakeasy Center, the Federal Reserve Board, Educational Testing Service, the University of Liege in Belgium, and ESCS.

Two examples illustrate how the general research subsystem of OASIS works—the OASIS aggregation routine for the Consumer Price Index(CPI) and two methods for calculating the coefficients of a two-stage least squares regression.

OASIS Routine for the Consumer Price Index

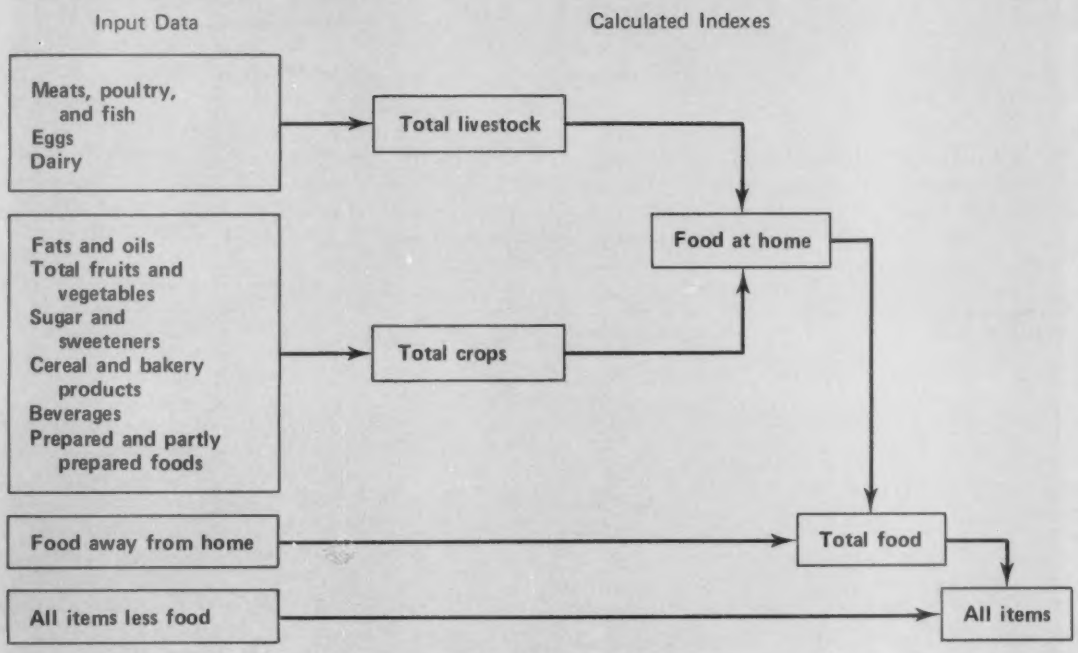
Figure 4 shows how the OASIS aggregation routine for the CPI operates. It starts with individual commodity groups, food away from home, and all items less food. Total crops and total livestock indexes are calculated, followed by food at home, total food, and, lastly, the total CPI. Figure 5 shows the program that calculates the indexes, and it shows the output.

Making the calculations is easy. CPI data and variable labels and weights are retrieved from a user library in statements 4 and 5. In practice, the CPI data are

Table 4—Capabilities of Research Subsystem, OASIS

Subject	Capability
General mathematics	Matrix algebra Set algebra Differential and integral calculus Differential equations Roots of polynomials Transformations of a variable
Mathematical programming	Linear programming Transportation algorithm Assignment algorithm Solution of under- and overdetermined system of linear equations
Estimation	Ordinary least squares Two-stage least squares Cochran-Orcutt and Hildreth-Lu corrections Polynomial distributed lags Shiller lags Random coefficient regression Nonlinear regressions Restricted least squares Probited analysis Ridge regression Principal components
Time series	Autocorrelation and autocovariance Partial autocorrelations Cross correlations Spectral analysis ARIMA modeling X-11 additive and multiplicative adjustments
Other statistics	Simple statistics Correlations Mean, variance, skewness, and kurtosis Standard error of the mean F- and t- probabilities Chi-squared probabilities and test Random numbers Frequency distributions Contingency tables
Other econometrics	Pooled time-series, cross-section estimation Moving averages and exponential smoothing Solution of nonlinear models

FIGURE 4
The CPI Calculator



retrieved from the OASIS data base. Input data are printed (lines 8 and 9); note use of "structured indexes" to print only the input data. Total livestock and total crop indexes are calculated (lines 12-17) by use of matrix multiplication and structured indexes. Other aggregates are calculated (lines 22-26) with array arithmetic and a loop; they could also be calculated with matrix algebra. Calculated indexes are printed (lines 29-30).

Two-Stage Least Squares Regression Coefficients

The second example shows two ways to calculate the coefficients of a two-stage least squares regression. Both methods are similar. The first method (lines 16-18 of figure 6) simply copies the formulas from a textbook into Speakeasy matrix notation. Someone just starting to use OASIS could do this work easily. A more sophisticated user would realize that this method involves numerical problems. The second method (lines 16-18) uses an extremely stable operator that solves over- and under-determined systems of linear equations. The second method is also easier to read.

OUTLOOK AND SITUATION ANALYSIS SUBSYSTEM AND OTHER SUBSYSTEMS

This subsystem consists of facilities specifically designed to support ESCS outlook and situation activities, several of which have been mentioned. They include the ESCS forecasting models; impact analysis facilities such as the cross-commodity model, Impact Multiplier System, and POLYSIM; consistency aids, such as the farm income and CPI calculators; and a forecast evaluation package that enables ESCS analysts to evaluate their forecasting accuracy. Some of these have been integrated into the OASIS computer system; others are being integrated.

While an intelligent subsystem and other modules do not currently exist, some work has begun on new tools to aid researchers and analysts. The intelligent subsystem will converse with analysts so that they can answer

FIGURE 5
CPI Calculator Program

```
EDITING CPIDEMO
  1 PROGRAM
  2 $
  3 $       RETRIEVE DATA FROM USER LIBRARY
  4 GET CPI ON MYKEEP
  5 GETLIST WGTLABEL ON MYKEEP
  6 $
  7 $       USE STRUCTURED INDEX TO PRINT INPUT DATA
  8 II=INTS(1 9),13,15
  9 TABULATE LABEL(II,) ,  CPI(II,)
 10 $
 11 $       CALCULATE TOTAL LIVESTOCK PRODUCTS
 12 I=INTS(1 3)
 13 CPI(10) = ROWMAT(:W(I)) * CPI(I)
 14 $
 15 $       CALCULATE TOTAL CROP PRODUCTS
 16 I=INTS(4 9)
 17 CPI(11) = ROWMAT(:W(I)) * CPI(I)
 18 $
 19 $     IN A LOOP, CALCULATE FOOD AT HOME (CPI INDEX NUMBER 12)
 20 $                          ALL FOOD (CPI INDEX NUMBER 14)
 21 $                          ALL ITEMS LESS FOOD (CPI INDEX NUMBER 16)
 22 B=12,14,16
 23 FOR A=1,3
 24 C=B(A)-2
 25 CPI(B(A),)=CPI(C,)*W(C)+CPI(C+1,)*W(C+1)
 26 ENDLOOP A
 27 $
 28 $       USE STRUCTURED INDEX TO PRINT CALCULATED INDEXES
 29 II=10,11,12,14,16
*30 TABULATE LABEL(II,) ,  CPI(II,)
```

MEATS, POULTRY, AND FISH	186.8	184.8	187.3	186
EGGS	158	135	149	159
DAIRY	179	181.5	182	184
FATS AND OILS	198	200	201	202
TOTAL FRUITS AND VEGETABLES	195.2	203.2	201.4	195.2
SUGAR AND SWEETENERS	243	246	249	252
CEREAL AND BAKERY PRODUCTS	192	195	197	200
BEVERAGES	328	318	308	298
PREP. AND PART. PREP. FOODS	184	186	188	190
FOOD AWAY FROM HOME	208	212	215	218
ALL ITEMS LESS FOOD	184.7	188.2	190.5	194.2
TOTAL LIVESTOCK	182.7	180.9	183.5	183.9
TOTAL CROPS	211.7	214.8	214	212.1
FOOD AT HOME	196.8	197.3	198.3	197.5
ALL FOOD	199.1	200.4	201.8	201.9
ALL ITEMS	188	191	193.1	195.9

FIGURE 6
Methods for Calculating Coefficients of Two-Stage Least Squares Regression

```
EDITING TWOSLS
  1 PROGRAM
  2 $      THIS PROGRAM CALCULATES TWO STAGE LEAST SQUARES
  3 $      IN TWO DIFFERENT WAYS.  THE SECOND WAY IS
  4 $      MORE STABLE AND EASIER.
  5 $
  6 $      THEY BOTH USE THE SAME NOTATION.  IT IS ASSUMED
  7 $      THAT ALL VARIABLES ARE DEFINED.
  8 $
  9 $      X  = MATRIX OF ALL PREDETERMINED VARIABLES
 10 $      Y1 = MATRIX OF ENDOGENOUS VARIABLES ON RHS OF EQUATION
 11 $      X1 = N X M MATRIX OF PREDETERMINED VARIABLES IN EQUATION
*12 $      DV = N X 1 MATRIX OF THE DEPENDENT VARIABLE
 13 $
 14 $   METHOD 1; EQUATIONS AS COPIED FROM TEXT
 15 $
 16     Y1HAT = X * INVERSE(TRANSPOSE(X)*X) * TRANSPOSE(X) * Y1
 17     Z = X1;   Z(,M+1) = Y1HAT
 18     INVERSE(TRANSPOSE(Z)*Z) * TRANSPOSE(Z) * DV
 19 $
 20 $   METHOD 2
 21 $
 22     Y1HAT = X * SIMEQUAT(X Y1)
 23     Z = X1;   Z(,M+1) = Y1HAT
 24     SIMEQUAT(Z DV)
```

policy questions more easily and consistently. Another module being developed helps analyze econometric models, and it shows the logical structure among the variables.

CONCLUSIONS

> **Blessed is he who expects nothing for he shall not be disappointed.**
>
> **Franklin's Rule**

While acknowledging that OASIS could not operate without data and the appropriate manipulative tools, the task force realized that the entire process had to be engineered to account for the basic fallibility of the human animal. The software that produces the tables, text, and graphs allows the most unsophisticated user the maximum number of opportunities to make a maximum number of mistakes and still correct the errors. This ability removes the system from the purview of the technicians and places it directly in the hands of users who might want to take advantage of the full range of services under the OASIS umbrella.

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COMPUTERIZED DATA SYSTEMS IN THE U.S. DEPARTMENT OF AGRICULTURE

- Four computerized data systems used in USDA are described, each in one part of a four-part article. The four systems are (1) an official estimates data base for agricultural statistics, (2) a remote access system for firm enterprise data, (3) the Land and Water Resources and Economic Modeling System (LAWREMS), and (4) the Comprehensive Resource Inventory and Evaluation System (CRIES).

- Keywords: Computerized data systems, agricultural statistics, resource inventory, firm enterprise data.

AN OFFICIAL ESTIMATES DATA BASE FOR AGRICULTURAL STATISTICS

By Mervyn R. Stuckey*

Agricultural statistics for the U.S. Department of Agriculture are collected, processed, summarized, and disseminated by the Statistics unit (formerly the Statistical Reporting Service) of the Economics, Statistics, and Cooperatives Service (ESCS) (see organization chart, p. 38). The Crop Reporting Board, part of ESCS-Statistics, was formed by a USDA regulation in 1905 to:

> prepare and issue . . . the official State and National estimates of the Department relating to crop production, livestock and livestock products, . . . Among these reports shall be the Monthly Crop Report . . . (USDA Administrative Regulation Title 1, Chapter 6, Paragraph 32E).

Members of the Crop Reporting Board make national crop and livestock estimates after carefully reviewing all State indications and recommendations submitted by the 44 State Statistical Offices from the 50 States. Thus, ESCS-Statistics is responsible for all official crop and livestock estimates and it must have them readily available for users.

During the late sixties, more and more users wanted these estimates in a machine-readable form. Probability sampling was being used in more surveys, which required computer processing. As a result, the former SRS set up an automatic data processing (ADP) intern training program. Analysts evolved a concept to make all crops and livestock official estimates readily available to users. As the ADP profession began to evaluate this concept, it became clear that a data base approach would best fit this need. Such an approach was to offer several advantages:

- Estimates would only need to be stored in one place, thus be easier to maintain (for example U.S. winter wheat production estimates for July 1977 would only be stored one place in the data base, not in several files);
- Many clerical and typing errors would be eliminated;
- Machine-readable data files could be developed upon request.

In many cases, data would not need to be rekeyed into a machine-readable form; thus, data users would save time and money.

Some disadvantages emerged as the Official Estimates Data Base was being developed. New skills were needed for data base design, different security risks would be encountered and, finally, operational procedures were changed, which required a higher skill level than had been needed with a manual system.

However, the advantages appeared to outweigh the problems. Design efforts were begun around 1971, and continued in 1973. The Official Estimates Data Base (OEDB) was to be one of several data bases which would include a data base each for crops, livestock, and prices. They were to be written in System 2000, a data base management system (DBMS) software package developed by a private corporation. This system is moderately complex and experienced ADP personnel must query and update it.

The crops data base was designed first, developed and tested in 1974. It became operational in a limited way early in 1975. Eventually, the crops data base would include official estimates for field crops (acreage, yield, production and season averages prices), noncitrus and

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citrus fruits, plus seed crops. Currently, it covers the previous 3 years of estimates and the current year's estimates.

In late 1975, design and development of the Crop Report System began, and indications and recommendations from the State Statistical Offices began to be incorporated every month into the crops data base. Camera-ready copy began to be produced for the monthly *Crop Production* report. Field offices of the former SRS were being connected to a telecommunications network (INFONET), which provided a definite advantage over mailing the indications and recommendations from the field offices and mailing copies of the report to them.

As a result, some field offices had more time to analyze the data, and the *Crop Production* report could be released about a day earlier. Field offices were getting camera-ready copy the same day it was released in Washington, D.C., which eliminated retyping some statistical tables. Field offices place their indications and recommendations into their own libraries; D.C. operations personnel access these libraries and bring all materials together for the Crop Report System.

A vegetables data base is also operational. A separate data base for vegetables had been considered essential because of the number of estimates involved (over 100 vegetable commodities); the need to maintain a "small" crops data base which would keep the response time within reasonable limits; and the low correlation between requests for data on vegetables and on crops.

Two data bases are now "on-line"; that is, they can be readily accessed by specific users: the crops data base and the vegetables data base. Each contains estimates from January 1975 through March 1978. These range in size from 2 million bytes (characters) for the 1975-78 crops data base to 200,000 bytes for vegetables. For the latter, a data base for 1969-74 is stored off-line on magnetic tape. Also stored this way are two crops data bases for field crops estimates (1954-62); field crops and nuts (1963-74); and citrus crops (1972-74).

A data element dictionary is maintained for the crops and vegetables data bases. Currently, it is a manual system. A separate page maintained for each data element contains such information as data element name, field length, relationships to other data elements if any, and a brief definition.

All data bases are on the INFONET network and tied into its Chicago computer center. Any technical maintenance is done by the Data Base Unit, Data Administration Section, Survey Division (see organization chart, p. 38). Unit members also develop new systems which access these data bases. Members of the Crops and Prices Data Unit in the Data Administration Section handle all production runs, making updates and queries as needed to fulfill data user requests. Access to the data bases is limited primarily to members of these two units, to whom requests are routed to avoid disclosure of confidential information. Machine-readable data files can be provided on magnetic tape, either in the Systems 2000 data base format or in a fixed-field, sequential-file format.

Additional systems are planned which will access the crops data base, in such areas as grain stocks, disposition and income. Refinements will also be made to the Crop Report System.

Further information on how to get a machine-readable data file from these data bases can be obtained from the Secretary of the Crop Reporting Board, Room 0233 South Building, U.S. Department of Agriculture, Washington, D.C. 20250.

A REMOTE ACCESS SYSTEM FOR FIRM ENTERPRISE DATA: AN OVERVIEW

By Paul Fuglestad*

Working with analysts at Oklahoma State University, members of the Agricultural Policy Analysis group in the Commodity Economics Division (CED) of the Economics, Statistics, and Cooperatives Service have modified the OSU budget generator system for USDA purposes. This revision known as the Firm Enterprise Data system (FEDS), provides "enterprise cost data that would be available for research purposes including interregional competition types of supply analysis and for analysis of policy questions."[1] Beginning in 1973, CED personnel have provided clientele with agricultural cost of production estimates, by area, for major crop and livestock types. Printed budgets, updated annually, are available upon request (from CED). They have proven very useful to program evaluators and researchers.

The FEDS budget generator is a versatile set of computer routines which "provides a completely computerized system for the development, modification, updating, and comparing of budgets."[2] Previously, access to the budget generator has been difficult for those wish-

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[1] Krenz, Ronald D. "Current Efforts at Estimation of Costs of Production in ERS." *Am. J. Agr. Econ.*, Vol. 57, Dec. 1975, p. 931.

[2] *Ibid.*, p. 932.

ing to build new budgets or to modify existing budgets, except for experienced users of the system. The system, which is cumbersome, requires a considerable amount of storage space, and it is difficult for the uninitiated to master.[3] The initiation fees are considerable in time needed by the researcher or other staff member to install and use the system. In addition, many potential users may not have the required computer facilities at their disposal. Thus, means were needed to enable access to the FEDS system from remote locations.

The Natural Resource Economics Division (NRED) has developed a "Remote Access System." It will allow entry to the FEDS computer files at Iowa State University from a remote telephone-access type terminal. The budget input data can be revised in any manner suited to the user and the revised budget can be listed on the terminal. This capability can help researchers and other staff who want to know the impact on production costs and returns for situations which differ from those assumed when the FEDS budgets were developed.

For instance, a researcher may not agree with an existing FEDS budget's product or input prices, yields, input mix, or schedule of operations. Through the FEDS Remote Access System, the researcher can tailor a budget.

This remote system was created partly in response to NRED's Pesticide Impact Analysis Group's need to evaluate the effects of proposed Environmental Protection Agency (EPA) pesticide bans on production costs and returns.[4] It is an outgrowth of a system I designed for Iowa State University Extension economists to allow field access to the OSU budget generator, also installed at ISU. For an understanding of the budget generator system and its use, see the OSU user's manual[5] and the companion FEDS users' manual.[6]

Running the system basically involves four separate phases: accessing a stored budget, revising it, submitting it for processing, and listing the results. The user responds to computer prompting to enter the requisite data. The FEDS "program" is automatically written and submitted to the operating system for processing. Upon completion, the results are retrieved and the budget is listed on the user's terminal.

In its current form, the Remote Access System is limited. For example, revised input data, monthly input summary, and labor and machinery requirements cannot be listed. Totally new budgets cannot be prepared and altered budgets cannot be stored. These additional procedures can be built into the access system—and may be if demand warrants. However, a point can be reached in which the expense and effort spent in learning and using the Remote Access System exceeds that in learning and using the FEDS system, making the former redundant. The Remote Access System offers ease of use through remote computer facilities.

THE LAND AND WATER RESOURCES AND ECONOMIC MODELING SYSTEM (LAWREMS)

By Howard Hogg and Paul Dyke*

A geographically dispersed, computer-linked data base and modeling system has resulted from efforts of a USDA task force acting on a request by the Senate Committee on Agriculture, Nutrition, and Forestry. In December 1976, the committee asked for USDA assistance in evaluation of the Department's land and water conservation programs. A digest of relevant information was transmitted to the Senate in December 1977. The task force identified four additional elements for study:

- Provide an overview of current physical, social, and institutional setting for these programs.
- Determine the effectiveness and efficiency of installed conservation practices in meeting intended objectives.
- Initiate evaluation of selected USDA programs and develop a plan for continuing evaluation.
- Coordinate, through interagency modeling team, development and maintenance of a Land and Water Resources and Economic Modeling System (LAWREMS).

The interagency LAWREMS team, formed as a result of the task force report, had three goals: (1) Promote cooperation among agencies by explaining the uses, limitations, and linkages among existing models and data systems; (2) Recommend needs for model development or modifications, along with data requirements, to permit land and water program evaluation and impact

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[3] The FEDS budgets for 1975, input data, and supporting software routines require 14 million bytes of storage.

[4] A second component of this activity involved development of a remote access version of the ISU-NRED linear programming system to support the pesticide program. See Fuglestad, Paul. "Using the ISUMODEL Remote Access System." Econ., Statis., Coop. Serv., U.S. Dept. Agr., unpubl.

[5] Kletke, Darrel D. *Operations Manual for the Oklahoma State University Enterprise Budget Generator.* Okla. State Univ., Agr. Expt. Sta., Res. Rpt. P-719, June 1975.

[6] U.S. Department of Agriculture. *User's Manual, Firm Enterprise Data System.* Econ. Res. Serv., July 1974.

analyses; and (3) Coordinate an effort to improve USDA and Congressional access to existing models, data systems, and proposed systems. The team did not assume responsibility for developing or operating models. Basic maintenance and control of these remains with the developer.

Several models and data systems with high potential for use in evaluation are already accessible through LAWREMS. These systems range from single-equation, site-specific models (such as those for estimating soil loss and flood damages) to the large-scale linear programming model used in the National Water Assessment. Appendix F of the *Initial Report on the Land and Conservation Program* to the U.S. Department of Agriculture contains both a preliminary inventory and classification of those models and also the related data sets which can be used in evaluating conservation practices.

The LAWREMS team expanded this inventory by compiling additional documentation and detail of these and other potential models and data sets, and they developed documentation on the accessibility of the existing models. This latter achievement was a crucial one because the systems involved are geographically scattered and serviced by many different hardware configurations. The team outlined a comprehensive system that will help fulfill the long-range analytical needs of USDA and the Congress for land and water program evaluation. Useful linkages among the inventoried models and data sets were designed and built into this system, and additional model development and data requirements were recommended.

Because the data and models incorporated in LAWREMS were not moved from their parent agency and location, an "intelligent" terminal was programmed to access various computers throughout the United States. This terminal has storage and programming capabilities which facilitate the transfer of data and model results, and it can send commands to the host computer and give instructions to the user. Run time is reduced as the user instructions are not transmitted over telephone lines. A users manual has been prepared for models and data now in the system. If current testing of LAWREMS is successful, ESCS will make it available to other agencies. This technique should provide a method of quickly consolidating results from several models into a single report.

THE COMPREHENSIVE RESOURCE INVENTORY AND EVALUATION SYSTEM

By John Putman, Larry Harrington, and T. B. Johnson*

The capacity to analyze the impacts of policies and programs on agricultural resources and their use is invaluable to developing countries, not only for resource policy analyses but also for a broad spectrum of economic analyses. Such capacity requires the development both of an inventory of agricultural resources and also of an appropriate analytical model.

Data deficiencies and limited local experience in model building hinder such development, however. Data are scarce and often of undetermined validity while trained personnel and funds for the collection of data are usually in even shorter supply in these countries. Limited experience in modeling leads these countries to import the required expertise. All too often, however, they are left with an imperfectly understood "black box" and with no capability for refinement and updating.

The Agricultural Production Potential Study Group (APPS) of the Natural Resource Economics Division (see organizational chart, p. 38) is currently constructing a Comprehensive Resource Inventory and Evaluation System (CRIES) for developing countries. Work is underway in the Dominican Republic, Nicaragua, and Costa Rica. The project is jointly funded by the U.S. Agency for International Development (AID) and USDA. Michigan State University analysts also have a major role through a cooperative agreement with ESCS.

The objectives of the study represent a merging of the interests of the two agencies:

- To provide in-country assistance to developing countries in analyzing the extent, quality, and use options of agricultural resources and in estimating the impact of alternative policies and programs (of major interest to AID);
- To develop a coordinated data concept, data system, and analytical framework adaptable to many countries and able to accumulate and transfer consistent information among countries to improve forecasts of regional and worldwide food production potential (of major interest to USDA).

The approach to resource modeling in developing countries has three main points:

- Generation and maintenance of a consistent and accurate agricultural sector data base for individual countries,
- Institutionalization of the formation system and analytical model in local decisionmaking processes,
- Development of an inventory and classification process which may collect and aggregate resource information from many countries in a conceptually consistent manner.

The basic analytical unit used is the Resource Produc-

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tion Unit (RPU). RPU's are defined as units of land sufficiently homogeneous in agroecological factors of soil, climate, and water resources to be reliable planning units for national/regional planning. RPU's are constructed by combining soil maps based upon soil taxonomy used by USDA's Soil Conservation Service and plant life zones used by USDA's Science and Education Administration.

The RPU map is the base, but just one component, however, of the CRIES system. In this system, one can cross-tabulate resource information with land tenure, cropping pattern, political boundary, and other information.

The development of CRIES has been marked by difficulties not usually encountered in U.S. resource analysis. Examples will be given for the Dominican Republic, the first country in which we have worked. The first major problem involved estimating national crop production and harvested area. There were enough data but inconsistency existed among the wide array of estimates available. The final selection of normalized national totals was made jointly with Dominican counterparts through a consensus process based on their view of the relative reliability of the data sources.

Information on major land use and cropping patterns was sparse. Although the Dominican Republic has what may be considered a good data set for a developing country, there is no comparison with the U.S. Conservation Needs Inventory; a consistent set of series on area planted, total production, and other variables; and an agricultural census. Cropping patterns were painfully reconstructed through use of a wide variety of secondary data sources, sample information on crop location, crop-specific maps, and expert opinion.

A major obstacle in estimating national area and production totals and current land use in the Dominican Republic is the abundance of multiple-cropping and intercropping. While there is some seasonality in rainfall, the Dominican Republic does not have even a short winter; thus, a given land unit can be harvested up to three times each year. Statistical reporting of crop area is in terms of "harvested area," which must be converted to "physical area" or a "land occupation" unit for inclusion in CRIES. If 3 crops were harvested from a given acre in 1 year, "harvested area" measurements would count 3 acres of land used. "Physical area" measurements would reduce this amount back to a single acre, with a note that each crop cycle only uses one-third of an acre annually. The ideal solution would require detailed, disaggregated knowledge of multiple-cropping and intercropping patterns, knowledge not available. An interim solution was the use of regional multiple-cropping coefficients to convert aggregate annual cropland to "physical area" terms.

Further work is underway in the Dominican Republic to develop improved estimates of land use, and national area and production totals. Satellite imagery is being used to identify major land use patterns. Data newly available from a national land ownership survey may be tapped for information on cropping patterns in general, and multiple-cropping and inter-cropping in particular. Preliminary results indicate that both satellite imagery and the cadastral survey may be surprisingly helpful. In the near future, however, the Dominican area sampling frame, developed with the help of USDA statisticians, will continue to provide most of the usable data on the agricultural sector.

The analytical model used in CRIES resembles that used in the U.S. river basin planning assistance and national water assessment. The CRIES model is a least-cost linear programming model constrained by the availability of agricultural resources, especially land, and exogenously determined levels and mixes of crops.

The activities of the linear programming model used in the Dominican Republic are identified by crop, RPU, and production technique. For each activity so defined, a yield and associated cost of production is estimated. Problems arise because "average" yield estimates have no budget data directly associated with them. Further, budgets expressed in physical inputs are rare and factor prices tend to be inconsistent. Resolution of the problem of correlating yield data with appropriate budget data is being given high priority.

The "first-generation" analytical model has been installed on a Dominican computer. Analytical model refinement should follow, not precede, development of in-country capability and refinement of the data base. The choice of a relatively simple model facilitates its institutionalization by minimizing the requirements for skilled personnel, for data, and for computer capacity.

The CRIES system has been used by Dominicans to examine the characteristics and alternative uses of state sugarcane land. The real benefits of a system such as CRIES to developing countries must be measured in increased quality of agricultural sector decisionmaking through applications such as this one.

A SURVEY OF AGRICULTURAL ECONOMICS LITERATURE: VOLUME 2, QUANTITATIVE METHODS IN AGRICULTURAL ECONOMICS 1940s TO 1970s

*Reviewed by Earl R. Swanson**

George G. Judge, Richard H. Day, S. R. Johnson, Gordon C. Rausser, and Lee R. Martin, eds. University of Minnesota Press, 2037 University Avenue, Minneapolis, MN. Published in Canada by Burns & MacEachern Ltd., Don Mills, Ontario. 473 pages. 1977. $25.

This publication confirms the wisdom of the decision made in 1968 by the American Agricultural Economics Association (AAEA) to initiate and support a survey of the post World War II literature in agricultural economics. Not many investments made by the AAEA will have such a high payoff, of which the most important component is the enlarged perspective on the development of our profession that readers will gain. Those of us who were impatient with the pace of activities involved in the planning, writing, review, editing, and publication of this series should now recognize that the end result justifies the wait of approximately 10 years.

Volume 2 is organized as follows:

Part I. *Estimation and Statistical Inference in Economics* written by George G. Judge. Preparation of outline: John P. Doll and Oscar R. Burt. Review of paper: Richard J. Foote and Wayne A. Fuller.

Part II. *On Economic Optimization: A Nontechnical Survey* written by Richard H. Day. Preparation of outline: John P. Doll and Oscar Burt. Review of paper: Verner G. Hurt. *Optimization Models in Agriculture and Resource Economics* written by Richard H. Day and Edward Sparling. Review of paper: Oscar R. Burt. *Agricultural Production Function Studies* written by Roger C. Woodworth. Review of paper: Chester B. Baker, Harold O. Carter, John C. Crecink, Lee M. Day, Richard J. Edwards, Irving F. Fellows, Burton L. French, Earl O. Heady, George D. Irwin, Earl W. Kehrberg, Luther H. Keller, W. W. McPherson, D. D. Mason, Ronald L. Mighell, Frank Orazem, G. A. Peterson, W. B. Sundquist, Earl R. Swanson, and W. D. Toussaint.

Part III. *Systems Analysis and Simulation in Agricultural and Resource Economics* written by S. R. Johnson and Gordon C. Rausser. Preparation of outline: S. R. Johnson and Gordon C. Rausser. Review of outline: Ludwig Eisgruber, Earl Fuller, Tom Manetsch, Thomas H. Naylor, and Warren H. Vincent. Review of paper: Oscar R. Burt, Ludwig Eisgruber, Albert N. Halter, and Thomas H. Naylor.

Part IV. *Developments in Agricultural Economic Data* written by M. L. Upchurch. Preparation of outline: Earl Houseman, Fred Abel, and Harry C. Trelogan. Review of outline: James T. Bonnen, James P. Cavin, Wayne Dexter, Clark Edwards, and Warren Grant. Review of paper: James T. Bonnen, James P. Cavin, Karl A. Fox, and Nathan M. Koffsky. *Technical Developments in Agricultural Estimates Methodology* written by Harry C. Trelogan, C. E. Caudill, Harold F. Huddleston, William E. Kibler, and Emerson Brooks. Review of paper: Lee R. Martin. *Assessment of Current Agricultural Data Base: An Information System Approach* written by James T. Bonnen. Review of paper: George G. Judge and Lee R. Martin. *Rural Economic and Social Statistics* written by W. Keith Bryant. Review of paper: James T. Bonnen, George G. Judge, Lee R. Martin, and Luther G. Tweeten.

Extensive reference lists are included after each paper in the first three parts of the volume, and a single list is included for the papers in part IV.

Because volume 1 has the title "Traditional Fields of Agricultural Economics," one might expect volume 2 to deal with "nontraditional" topics, in the sense of neatly compartmentalized subject matter areas of agricultural economics which have emerged in the last three decades. Such is not the case. Instead, the authors of volume 2 sketch the pre-1940 historical contexts in each of their surveys, indicating traditions which often predate those that emerged after agricultural economics became recognized as a discipline. Perhaps of greater importance is the pervasiveness of the impact, both actual and potential, of quantitative concepts and methods on the traditional fields of agricultural economics. Thus it is inaccurate to define those topics as comprising a separate field of agricultural economics, either traditional or nontraditional. Nevertheless, because of the crucial role of quantitative methods in determining the character of agricultural economics in the period covered, the topics included in this volume clearly deserve the space they received in this three-volume literature survey.

The introduction provides a useful framework for viewing the search for knowledge in terms of the relationship between the systems of logic and experimentation. The reader may find it of interest to compare this paradigm with that of Bonnen's agricultural information system (pp. 395-407) before proceeding.

In part I, Judge provides a succinct decade-by-decade history of the development of econometric theory and its applications, noting that the forties marked the beginning of modern econometrics. He suggests that, although we now understand better the linkages between theory and measurement, substantial questions remain as a challenge in the years ahead. Foote, speaking from a

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background in government, industry, and the university, concludes in his review that successful models have been formulated and fitted despite theory and data inadequacies.

Part II begins with Day's lucid exposition of economic optimization which delivers on the promise of being "nontechnical". Describing the linkages of modern optimization theory to the history of classical and neoclassical economic theory does much to illuminate the importance of developments in optimization theory for agricultural economists. The classifications developed provide an excellent frame for this paper's overview role. In the following paper, Day and Sparling survey the use of optimization models in agricultural and resource economics. Fortunately, the authors do not preoccupy themselves with precise identification of first-place winners in the race to illustrate a newly developed optimization model with agricultural data. This survey paper is substantially strengthened by its organization around subject matter areas such as food and diet, and farm and agribusiness management; and by the distinctions made among classical, neoclassical, and modern optimizing theories.

In the concluding article in part II, Woodworth surveys the agricultural production function studies—aggregate, crop, livestock, and poultry. In addition to noting the substantive value, the author points out that the experience of agricultural economists working with statisticians and biological scientists on these studies demonstrates the potential for interdisciplinary approaches to problem solving. The decline in participation by agricultural economists in these studies reflects, in part, the ability of production scientists to design their own studies based on the static theory of the firm. The statistical design requirements of newer decision models which incorporate risk and uncertainty may call for the re-entry of economists into this type of research.

Part III, occupying nearly one-third of the volume, consists of an ambitious and successful attempt to give structure to the amorphous area of systems analysis and simulation. Although the importance of this topic may not justify such a large share of a volume devoted to it, one must recognize that the authors assumed a substantial burden in exploring the often very loosely defined area of systems analysis. In fact, the discussion of applications comprises a rather small, but very informative part, of the paper, and it includes the classification and brief description of over 100 gaming and simulation models used in agricultural and natural resource economics.

Part IV begins with Upchurch's carefully documented account of the development of agricultural economic data systems.

Few important events in our Nation's agricultural history have not called for a response from those agencies charged with providing a data base for policy decisions. Thus, Upchurch also provides insights into the development of U.S. agricultural history, especially since the Civil War.

In a paper on the methodology of agricultural estimates, in part IV, Trelogan and his associates trace the development of the U.S. agricultural information system from its beginnings, with emphasis on the role of statistical methodology in improving crop and livestock estimates after World War II. Of special interest is the development of the Master Sample of Agriculture in the forties and the progress in the application of probability sampling after 1950, especially the objective yield estimation procedures based on actual measurements of plants on small sample plots.

Bonnen, also in part IV, assesses our current agricultural data base in the context of an agricultural information system which distinguishes between information and data. The system includes the process of data collection *and* provisions for the analysis and interpretation necessary for the data to be used in decision-making. The information system concept does much to improve our understanding of an ideal framework in which the expressed demands for agricultural data elicit responses from the data collection system.

Making these concepts operational is a critical task, the magnitude of which should not be underestimated. For example, the role of the "establishment" is emerging slowly as an observational unit of a analysis for data collection at the farm level. Data in this form may be more easily integrated with data from the rest of the food sector.

The special needs for data on the economic and social characteristics of rural people and areas are discussed in a paper by Bryant in part IV. He notes that, in contrast to the concentration of data collection for commercial agriculture in the U.S. Department of Agriculture, rural economic and social statistics are generated by a number of agencies, including some at the local and regional level. Conceptual and definitional problems have been particularly troublesome in developing an agenda for the data base in this area. Part IV concludes with a useful classification of over 800 references dealing with various aspects of an agricultural economic information system.

No doubt the elaborate structure for preparation and review of outlines and papers helped to insure a balanced and objective view in each of the papers. Credit is also due the authors for rarely acting as advocates in surveying literature in areas in which they themselves have often been in the vanguard of contributors.

The substantial impacts of the quantitative concepts and methods surveyed in parts I, II, and III on the content of our professional literature are evident in publications such as the *American Journal of Agricultural Economics* and *Agricultural Economics Research*. The lag between development and adoption in replacing the symbols of the models with data from agriculture has varied a good deal among the various conceptual models reviewed. Linear programming has probably had the most rapid diffusion rate.

But we should not confuse the "applications" referred to so often in parts I, II, and III with bona fide applications in which results form an important, clearly identified base for

decisions in either the public or private sector. Consequently, many of the applications cited would be more correctly called "illustrations" which suggest a more rigorous way of thinking about problems of choice. This impact on the logic of decision-making should be viewed as the main product rather than an incidental byproduct of the methods and analytical frames of reference presented in parts I, II, and III.

In contrast, the procedures reviewed in part IV in the paper by Trelogan and his colleagues on methodology for estimating agricultural data not only found their way into the professional literature but also were adopted and made operational by those charged with collection of data. It is of interest that the first article in the first issue of *Agricultural Economics Research* in 1949 dealt with design of samples for surveys. But, without minimizing in any way the contribution of the various Federal agencies in providing the agricultural data base, it is much easier to improve the precision of data estimates than to decide on the data needed in the first place. The questions posed by Bonnen in part IV on the framework of an agricultural information system remain the fundamental and difficult ones.

Finally, will the progress during the last three decades, in terms of the beneficial impacts on agricultural economics of the topics surveyed in this volume, be repeated in the next three decades? It is somewhat ominous to note that a rather large fraction of the editors and authors of papers in this volume, themselves pioneers in the development of concepts and methods reviewed, no longer reside in institutional settings, such as departments of agricultural economics or the U.S. Department of Agriculture, in which the potential for interaction with agricultural economists is high. If the field of agricultural economics is to continue to gain from the methodological base outlined in this volume, and if agricultural economists are to continue to participate in improvements in this base, provisions must be made to keep the innovators within our ranks. Clearly, some of the problems we will face in the next 30 years will need new methodological approaches, and the toolmakers should be kept close at hand. ■

INCOME DISTRIBUTION POLICY IN DEVELOPING COUNTRIES: A CASE STUDY OF KOREA

Irma Adelman and Sherman Robinson. Stanford University Press, Palo Alto, 346 pages. 1978. $12.50.

*Reviewed by William F. Fox**

Economists have become increasingly aware that in less developed countries rapid growth in output does not guarantee improvement in the relative or absolute incomes of low-income groups. In Korea, for example, the rapid growth rates of the late sixties and early seventies left the relative distribution of income essentially unchanged. Thus, in absolute terms, upper income groups made very substantial gains.

If growth alone will not improve the relative lot of persons living in poverty, perhaps there are ways to stimulate simultaneous economic growth and improvement in the income distribution. In a noteworthy manner, this book seeks to identify policies which are the most effective in improving the distribution of income, as measured by its size and by the percentage of families in poverty, while other legitimate economic goals are maintained.

The two basic endeavors of the authors are (1) development of a theoretically grounded model to simulate the impact of policy intervention on the distribution of income and (2) application of the model to the Republic of Korea.[1] As the model simulates the Korean economy, it is not completely general. However, the general conclusions probably apply to a wide range of developed and developing nations.

The model's core is a static stage in which all wages, prices, production, employment, incomes, and the distribution of income are determined. There are also two dynamic stages. One attractive feature of the book is that major discussion of the model is saved for several appendices; thus, the casual reader can skip these if desired, and concentrate more on policy implications.

Comparative static implications of the model are derived for a series of policy alternatives. Dynamic results are determined for each of the first 9 years after a policy intervention. Simulation results reveal that adjustment to proposed policies generally occurs through wage and price changes, and quantities remain very stable. This behavior implies first that most planning models, with their emphasis on fixed prices and changing output, will be inappropriate for analyzing impacts of policy interventions on income distribution. Second, the important factors for determining policy impacts on poverty will be changes in relative prices of goods produced and consumed by low-income groups.

As low-income classes are heavily concentrated in rural areas, policies must have a strong influence on rural populations to alter the distribution of income. At the same time, all sectors of the economy must be considered jointly because the interaction among sectors will result in large, possibly undesirable spillovers of policy effects.

Throughout the 49 policy experiments simulated with the model, two sources proved ultimately responsible for improvement in the distribution of income. One, changes in the agricultural terms of trade, was found to be very responsive to demand and supply pressures. Any policy which did not maintain or improve these terms of trade was counterproductive or unsuccessful. For example, programs which increase agricultural productivity without specifically maintaining the agricultural terms of trade worsen the distribution of income. It should be noted that interactions among the sectors cause nearly every set of policy interventions to alter the terms of trade.

Two, encouraging migration from rural to urban areas was an important way to alleviate poverty because it tended to increase incomes of the remaining agricultural workers. However, to a certain extent, rural poverty becomes urban poverty through migration. Also, congestion and

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[1] For many of the policy implications, see Adelman, Irma. "Policies for Equitable Growth in Developing Countries." In *Lectures in Agricultural Economics*. Economic Research Service, U.S. Department of Agriculture, unnumbered, June 1977, pp. 25-32.

environmental costs from increased urbanization are ignored in the model. Thus, in real terms, the migrants to urban areas, as well as the urban residents, may be worse off.

Many interesting conclusions emanate from this study. In general, it seems that most policies designed to improve the distribution of income will not be effective. For nearly every experiment, the size distribution of income was found to be stable; only the functional distribution of income appears to be sensitive to policy interventions. Therefore, comprehensive policy packages are best for altering the distribution of income. Either enormous programs or structural changes in the economic system are necessary to significantly alter the size distribution of income.

Many of the proposed antipoverty programs eventually help the rich middle-income groups more than the poor. In particular, programs which target areas rather than people are likely to experience significant spillovers away from the desired beneficiaries to other people as well. For example, programs designed to improve incomes in rural areas by increasing the agricultural terms of trade will significantly increase incomes of rich farmers.

Several individual experiments had unanticipated results. Nationalization of economic activity did not alter income distribution. Instead, it merely transferred income from capitalists to bureaucrats. Another relatively ineffective program was population control; at best, the impacts of lower population growth were minor in adjusting the distribution of income.

Perhaps the model's greatest shortcoming is a tendency to ignore the development of rural-based industry as a way to alleviate rural poverty. Although the model includes rural sites for some industrial sectors, the book's emphasis suggests a dichotomy wherein urban areas are responsible for manufacturing and rural areas, for agriculture. Only one experiment, a combination of rural public works and small-scale industry, examines the impact of rural industrial development on the income distribution. Although improvement in the absolute incomes of the poorest group was more favorable for this experiment than for any other single policy intervention, industrial development in rural areas received little attention.

In an alternative approach, Clark Edwards viewed the economy of developing countries as containing four interacting sectors: traditional agriculture, advancing agriculture, urban-based industry, and rural-based industry.[2] Advancing agriculture and urban-based industry are inextricably joined through forward and backward linkages. He also found that the economic well-being of traditional agriculture and rural-based industries is closely related through the factor and output markets. Edwards' findings, in addition to the authors', suggest that this book's authors slight the potentially most important program for redistributing income—development of rural-based industry.

The book's structure makes it useful to three different sets of readers. First, implications for development and income redistribution policies would prove valuable for persons with specific interests in Korea. Second, as the model and many of the conclusions are sufficiently universal to be applied elsewhere, the book would interest policymakers in general. Third, because several appendices develop the model and discuss solution techniques, model builders and econometricians would profit from study of the appendices. ■

[2] Edwards, Clark. *Strategies for Balanced Growth in Developing Countries*. Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 375, July 1977.

FARMING FOR PROFIT IN A HUNGRY WORLD: CAPITAL AND THE CRISIS IN AGRICULTURE

Perelman, Michael. Landmark Studies, Allanheld, Osmun, Montclair, N.J. and Universe Books, New York; 1977, xii + 238 pp.

Reviewed by
*Philip Martin and Quirino Paris**

What is the state and direction of U.S. agriculture? Do current conditions, practices, and motivations make it the paradigm for world agriculture or a Frankenstein whose inexorable diffusion threatens worldwide catastrophe? Whether model or villain, what forces have shaped agriculture and what factors continue to propel the structural transformation of the U.S. food system? As food is essential and food production central in all economic systems, answers to these questions are of vital importance in assessing the current status and projecting the future economic and social well-being of society.

Dr. Perelman addresses these questions in a wide ranging, liberally referenced book *Farming for Profit in a Hungry World: Capital and the Crisis in Agriculture*. For Perelman, the essential feature of U.S. agriculture is its efficiency orientation. Despite the pernicious, indeed suicidal, longrun effects of this orientation, the continual drive for increasing production and minimizing costs is so firmly entrenched in the United States that a reversal in priorities can arise only with a radical reorientation of agriculture. This reorientation is urgent, Perelman argues, because of the importance of U.S. agriculture and its techniques on a global scale.

Part one of the five-part book introduces the concept of economic efficiency and argues that an alternative motivation, energy efficiency, is a better basis for organizing agricultural production. Part two is an historical overview of the forces which gave rise to an efficiency-based American agriculture. Part three explores the impacts of capital-labor substitution and land consolidation

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in America, while part four examines the impacts of the adoption of American agricultural techniques in developing countries. Part five contains the argument that belief in and adoption of neoclassical economic principles have accentuated rather than mitigated the plight of farmers and consumers in the economic system.

For Perelman, the basic flaw in U.S. agriculture is that production and consumption decisions are motivated by the prices generated in imperfect markets. Price-motivated choice behavior gives rise to the overuse of fossil fuels in food production. According to Perelman, U.S. agriculture requires 2.5 calories of fossil fuel for each food calorie produced while some forms of rice production in China result in 53.5 calories of food for each calorie of human energy expended in production (p. 12).

American production and consumption decisions, motivated by the prevailing relative prices of energy, capital, and labor, result in an economically efficient but energy inefficient system, a situation which leads Perelman to call a global adoption of the U.S. agricultural system "suicidal" (p. 14). American agriculture can serve as a worldwide paradigm only if it is converted from its base of economic efficiency to one of energy efficiency. This conversion is vital because energy sources, including "fossil fuels and minerals," can be exhausted, while "farming, properly conducted, has the potential to repeat itself indefinitely" (p. 14).

Although the Perelman book contains a variety of insights and a wealth of historical anecdotes, it does not provide a unified theory which explains why the current U.S. agricultural system is inexorably self-destructive. Perelman is quick to see doom emanating from the eventual exhaustion of fossil fuel reserves. But he bases his prediction of catastrophe on the inability of a market system to correctly anticipate future demands and thus price resources to reflect their eventual depletion. Although the problem of pricing depletable resources has been recognized for some time, the fact remains that we have few good examples of how this pricing behavior has resulted in even partial catastrophe in the past. The burden of Perelman's argument rests on showing that such a catastrophe will result from the shortsightedness of the pricing system in the future.

The price system is flawed, in Perelman's view, because "prices are not a measure of scarcity" (p. 62). Instead of indicating relative scarcities in relation to wants, he finds that prices reflect (and presumably change only with) "the relative powers of economic forces" (p. 62). If relative power dictates the use of scarce fossil fuels, society in general and agriculture in particular will "overuse" these exhaustible energy sources despite the pleas of clairvoyant Cassandras.

Given today's institutions and behavioral patterns, it is hard to persuade others that society must radically alter its economic underpinnings, that economic behavior should be motivated by an "energy theory of value" rather than a price system which reflects, however imperfectly, preferences and scarcity. But difficulty in achieving acceptance is accentuated by inconsistency and lack of a clearly specified alternative. Perelman argues that prices are not determined by scarcity and preferences in a market system, but he finds that "in the U.S., for example, the scarcity of labor allowed the nineteenth-century workers to extract higher wages because they could threaten to withdraw their labor and begin a farm" (p. 64). If scarcity merely gives rise to the "economic power" which does determine prices, then we are using semantics as a veil to divert attention from real economic forces.

Definitional inconsistency may seem trivial if the alternative advanced is clearly superior to a system with acknowledged shortcomings. But Perelman's vision assumes a Delphic aura because it fails to specify exactly what the superior motivator of behavior might be; that is, what the new efficiency criterion is. He argues that agriculture in primitive societies "could be said to be efficient, from the point of view of its members, because it taught the people about the harmony between human beings and nature at the same time as it reinforced the social relations which were necessary for survival" (p. 229). Subsequent agricultural systems were deemed efficient if they "produced good soldiers" or if they were "profitable."

The ambiguity surrounding the alternative agricultural utopia raises two issues. The first is epistemological—can the participants in any agricultural system at a point in time know whether it is "efficient" in the "correct" long-term sense, or must they await history's judgment on their particular society? If the proper efficiency orientation *can* be determined during the life of the system, who should make the determination and how should it be made? Imposi-

In Earlier Issues

Dr. (William Edwards) Deming . . . at a comparatively early age deserves to be recognized as the dean of scientific statisticians in the Federal service, where he has initiated, participated in, and accelerated many of the advances in the science. . . . Fellow workers know well, and sometimes to their chagrin, the passion for consistency, thoroughness, and rigor . . . (he) does not believe in propounding statistical mysteries nor in requiring the reader to accept propositions on faith.

Richard O. Been
Vol. 2, No. 4, Oct. 1950
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tion of a system invites charges of elitism, but rational persuasion must overcome doubts about ambiguity and the very real adjustment costs necessary in any social transformation.

The problems of knowing and specifying agricultural alternatives are real. But in a complex industrial society, one must organize both agricultural and nonagricultural sectors. If the organization of agriculture is changed, what happens to the rest of industry?

For Perelman, agriculture should be organized to provide food and to define both social relations and the relationship between man and nature. When agriculture is reorganized to embrace a profit motive, this basis for human subsistence is destroyed. The profit motive was a cultural innovation, the antecedent which permitted a social organization emphasizing markets, exchange, innovation, and industrialization. Once imbued in culture and industry, profits quickly assumed a dominant role in agriculture. Perelman draws distinctions between the industrial and agricultural sectors, arguing that profits are bad (or worse) in agriculture because they destroy underlying human relationships. Even if profits are "wrong" in agriculture, should they motivate behavior in industry? If so, what is the proper nexus between agriculture and industry? This issue is not explicitly addressed.

One recurring theme is the superiority of the Chinese agricultural system. After presenting a litany of achievements in Chinese agriculture, the author ascribes China's "phenomenal success" in agriculture to "an environmental consciousness" rather than a profit orientation (p. 197). If labor-intensive or "ecologically sound" practices cannot be justified at prevailing relative (world) prices, they are sure to be vindicated by relative prices in the future. Such an argument simply implies that individuals differ in their assessment of future prices, not that behaving as if the future is now is, in any sense, superior. Even if one were convinced that a proper economic orientation would maximize production 50 years hence, we need only note "Mao said that it would be wrong to attempt to apply the Chinese approach elsewhere" (p. 190). ■

RURAL POVERTY AND THE POLICY CRISIS

Robert O. Coppedge and Carlton G. Davis, editors. Iowa State University Press, Ames, Iowa 50010, 220 pages. 1977. $9.50.

*Reviewed by Thomas F. Davis**

Although the United States has achieved a median family income of approximately $15,000 and per capita personal income approaching $6,500, many workers and families live at or below the official poverty threshold. Early in the sixties, one person in five was poor.

Since that time, major strides have been made in addressing the poverty issue in the United States and its concomitant social and psychological deprivation. These efforts have been fairly successful in reducing both the absolute level and the incidence of poverty on a national basis. As of 1976, the incidence of poverty for persons was below 12 percent. That progress has been made in eliminating income disparities offers little solace to the current poor population, however. The tenacity of these problems and their geographic concentration raises important questions regarding national policies in the income equality arena.

Within that arena, nonmetropolitan Americans generally have lower incomes than metropolitan residents. In 1976, people living in nonmetropolitan areas accounted for 32 percent of the total population but 39 percent of the country's poor. The South continues to lead, containing over 40 percent of the total number of the poor. Many questions as to regional incidence of poverty remain unanswered and often unaddressed.

Rural Poverty and the Policy Crisis grew out of a national symposium in 1975, the purpose of which was to "identify and assess the current dimensions of poverty in rural America." Although economic issues were stressed, the symposium format explicitly incorporated the interrelationships of many disciplines. Papers were invited from general and agricultural economists, anthropologists, sociologists, and academic and government administrators.

Twelve chapters, organized into four distinct parts, provide a dynamic analytic framework for poverty evaluation and policy prescription. Part one, "Conceptual Dimensions of Poverty Issues and Problems," contains a cross-disciplinary conceptual framework for classification of income-related factors. The authors evaluate the implications of the major definitional and empirical measurement issues generated by official poverty statistics, and they describe many inconsistencies between economic theory and observed income distribution data in an international context. Authors of this section include Theodore W. Schultz and both the book's coeditors.

Part two, "Alternative Evaluations of the Cost of Rural Poverty in the United States," combines the works of Luther Tweeten and Neal O. Walker, and Sally Bould-Van Til, with discussions by J. Dean Jansma and Gerald R. Leslie on economic and social costs of American poverty.

In part three, "Alternative Theoretical Frameworks for Viewing Rural Poverty and Income Distribution," contributors compare, contrast, and evaluate three different theoretical frameworks (neoclassical economic theory, the radical critique, and social marginalization theory) within which the problems of income distribution and poverty can be evaluated. Papers in this section were prepared by G. Edward Schuh, Joseph Persky, Harland T. Padfield, and John A. Young, and Bobby R. Eddleman. Discussants were Robert D. Emerson, Edna T. Lochman, and Benjamin L. Gorman.

Authors in part four, "Institutional Role and Responsibilities on Poverty Policy and Issues," analyze some of the effects of poverty on rural people, review current poverty programs and consider the impact of pending public programs on the target population, and explore the nature of poverty and the university's role in combating it. Emil W. Owens, D. Lee Bawden, and Emery N. Castle prepared chapters for this section while Lynn M. Daft, Melvin L. Upchurch, and W. W. McPherson provided enlightening discussion.

The volume's forward states that:

> This book will be useful not only to teachers and

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researchers who have a professional interest in the economics of rural poverty, but also to administrators, legislators, and citizens interested in this important problem area of contemporary American society.

The interested citizen may have some difficulty with certain sections of this collection because of the abstract concepts and analytical devices. But for a general statement of the problem and understanding of the basic issues involved, such a reader may be well advised to consider its contents.

The volume's 220 pages have left some distinct impressions on this reviewer. At the top of the list is the use of the three conceptual frameworks mentioned above. The use of traditional, Marxian, and behavioral modes of analysis in the discussion of rural poverty will add to the reader's knowledge and insight. The goal of the book is to "consider the validity of these three conceptual frameworks and to what degree they are related to each other or to some grander scheme." The aim is the increase of economic knowledge so that better models may be constructed, more effective policies prescribed, and an inequity crisis averted. Certainly, economic knowledge has increased with the publication of this volume. It remains to be seen whether the application of this knowledge will be effective.

Another impression is that the use of the term "rural" throughout the text is inconsistent and often inapplicable. Carlton Davis defines "rural" in his early chapter and makes the distinction between "rural" and "nonmetropolitan." Yet, in the remainder of the book there is no consistent use of the definition for "rural." Frequently, "farm" and "nonmetropolitan" seem to be used as synonyms for "rural." Other chapters contain no reference to place of residence. This reviewer thinks that it should be made clear that "rural," "farm," and "nonmetropolitan" are adjectives with distinctly different meanings and that policy prescriptions made for one area may not affect the others. Even if the term "rural" is used in its proper definitional context, the question of poverty in rural areas does not imply that one industry—agriculture—is inadequate or at fault. The industrial mix in rural areas has changed substantially since the sixties, and it can be influenced through insightful public policy. ■

In Earlier Issues

Where long-term indebtedness is involved it is always better to buy a fixed capital asset during low prices, but as a practical matter this would mean that a generation of young farmers might have to forego the purchase of farms. A young farmer cannot 'forestall middle age' more than a few years while waiting for the business cycle to change. There is a growing body of opinion that the time for a young man to buy a farm or a home is when he is financially ready; then he can use this asset during his productive years. He might want to vary the terms of finance, percentage of equity, and method of repayment, depending upon the stage of the business cycle in which he buys.

Earl L. Butz
Vol. 2, No. 4, Oct. 1950
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TRADITION AND DYNAMICS IN SMALL FARM AGRICULTURE: ECONOMIC STUDIES IN ASIA, AFRICA, AND LATIN AMERICA

Iowa State University Press, Ames, Iowa. 1977.

*Reviewed by Emmy Simmons**

Books on economic development and the agricultural transformation, such as those by Mellor, Hayami and Ruttan, and Johnston and Kilby, have become standard texts for students of agricultural development. These books do not, however, enable the student to focus in detail on how the broader economic variables interact in a particular agricultural environment or on farmers' responses to a specific program of change. This small book attempts to fill this need for supplementary information by bringing together case studies of small farms in Nigeria, Brazil, Thailand, Pakistan, Venezuela, and Mexico.

Traditional Agriculture

David W. Norman's descriptive presentation and analysis of a dryland farming system in northern Nigeria demonstrates the capacity of farming households to allocate current resources efficiently (in economic terms) while providing maximum security in food production and income. He concludes that improved technology, facilitative infrastructure, and extension test plots on farmers' own farms are essential to bring about the degree of change needed to raise farmers' productivity substantially.

A. John de Boer and Delane E. Welsch analyze a mixed farming system in northeastern Thailand to learn why livestock production does not increase despite greatly increased demand for meat. Again, farmers are shown to be rational and efficient in their allocation of current resources. Complementary innovations in production systems for *both* crop and livestock activities were judged to be prerequisites for increasing cattle output.

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Norman Rask's analysis of farmers in the Rio Grande do Sul area of southern Brazil is less specifically focused than the other "traditional agriculture" studies. He contrasts the relative modernity of large commercial farms and the low levels of technological advance of smallholder agriculture. In somewhat more detail, he looks at small farmers in three districts. There appears to be considerable variation in farming systems within the three districts but he characterizes the three situations very generally. The conclusions suffer somewhat from this treatment, particularly as to constraints and potentials peculiar to small farmers.

"Modern" Agriculture

Jerry B. Eckert contributes an account and analysis of the successful introduction of Mexican high-yielding wheat varieties in Pakistan. Of particular interest is the description of apparent impacts of agricultural production changes on a whole spectrum of institutions and social customs. He concludes that Pakistani wheat farmers have moved away from traditional stability and security and they will never again achieve the near-equilibrium of the traditional system.

William C. Thiesenhusen presents a contrasting case of technological change. An agricultural resettlement/colonization scheme in central Venezuela undertaken in 1960 is analyzed at different points in the following decade. Among other effects, distorted factor prices led to inefficient use of land and labor resources, and insufficient markets, to low productivity. The end result of the scheme was highly skewed productivity and income distributions; the poorest farmers were apparently unable to achieve subsistence without substantial credit.

D. K. Freebairn's historical analysis of an *ejido* in Sonora State, Mexico, sheds a slightly different light on resettlement. The author considers institutional and social as well as production aspects of agricultural change. The *ejido* approach makes wider participation possible even though experience shows that the original communal approach has not endured well in Mexico. While the original purpose of the land reform has been distorted through time, Freebairn concludes that *ejidos* have functioned well enough to provide a viable mechanism for achieving both wider participation and a modern agriculture, provided that the government provides essential social infrastructure as well.

Conclusions

The case studies gave this reviewer a healthy respect for the difficulties governments face in formulating programs of change, implementing them in the short term, and in ensuring that, in the longer term, whole sets of consistently appropriate actions to further guide the process of agricultural change are taken. In the concluding chapter, Robert Stevens goes far beyond the more modest implications for government action which most of the case studies offer. His recommendations follow the standard checklist of institutional constraints, government commitment, land reform prices and taxes, technology development and testing, increasing availability of new inputs, and so on. He does not take a new or very hard look at the combination of factors which have led to technological stagnation or to the dynamic changes presented in the case studies. While his conclusions thus disappoint and frustrate the reader, the utility of this little book as supplementary reading to standard texts and as a source of comparative experience in smallholder agriculture makes it a worthwhile addition to the agricultural development literature. ■

A NOTE ON CONFIDENCE INTERVALS FOR CORN PRICE AND UTILIZATION FORECASTS

*By John Spriggs**

In a recent article in this Journal, L. Teigen and T. Bell use a structurally estimated econometric model to derive estimates for variance in the forecast error.[1] The method they use is considerably simpler than the conventional method of Goldberger, Nager, and Odeh.[2] However, my objective here is to argue that Teigen and Bell's results apparently bear no relation to those obtained by the Goldberger approach. As a result, one should be careful not to interpret the two approaches as being related.

The problem occurs when Teigen/Bell attempt to account for variation due to the parameter estimates. The procedure, they state, is based on intuition. They inflate the standard errors of estimate by a factor of $(1 + k/n)$, where k is the average number of parameters in a structural equation and n, the number of observations. Empirically, this adjustment appears to be much too small.

I took the same corn model used by Teigen/Bell, omitting the production side for simplicity so that only the post-harvest situation was considered. (This simplification does not affect the conclusions drawn). The estimated standard errors of the parameters were calculated by dividing each coefficient by its respective t-value.

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[1] Teigen, L. D., and T. M. Bell. "Confidence Intervals for Corn Price and Utilization Forecasts." *Agricultural Economics Research*. Vol. 30, no. 1, January 1978.

[2] The Goldberger, Nager, Odeh method (hereafter referred to as Goldberger method) is generally accepted when the exogenous variables in the period being forecast are not stochastic. Goldberger, A. S., A. L. Nager, and H. S. Odeh. "The Covariance Matrices of Reduced-Form Coefficients and of Forecasts for a Structural Econometric Model." *Econometrica*. Vol. 29, no. 4, October 1961.

In two equations, the *t*-values on the intercept term were omitted in the Teigen/Bell article. For these, the standard errors were assumed to be zero. All covariances between parameters were assumed to be zero. The values of the exogenous variables in the period of the forecast were those in table 2 of the Teigen/Bell article.

It can be shown (Goldberger, p. 562) that $A = FBF' + C$,

where

- A = variance-covariance matrix of forecast errors
- B = variance-covariance matrix of reduced-form coefficients
- C = variance-covariance matrix of reduced-form disturbances, and
- F = matrix displaying the values of the exogenous variables in the forecast period.

The matrices $F\hat{B}F'$ and $\hat{C}$ were calculated from the estimated structural form where "^" translates as "estimated". The results appear in tables 1 and 2.

In these tables, the variables are defined as follows:

- FD = feed demand, corn
- FO = food demand, corn
- CX = commercial exports, corn
- CS = ending commercial stocks, corn
- PC = corn price
- $V_1 \ldots V_5$ = disturbances corresponding to the five reduced-form equations.

The variances of the errors in the forecast may be obtained by adding each diagonal element of table 1 to the corresponding diagonal element of table 2. Standard errors of forecast are obtained as the square roots of these variances. The standard errors using the Goldberger approach are compared below with those obtained by Teigen/Bell using the latter's adjustment for variation due to the parameter estimates:

Variable	Goldberger approach	Teigen/Bell approach
FD	1023·	102·8
FO	43·43	16·09
CX	1177·	63·72
CS	542·8	88·68
PC	1·309	·1368

As may be seen, the Goldberger estimates are larger than the Teigen/Bell estimates in every case. Apart from this, there is no apparent relationship between the two sets of estimates. The Teigen/Bell estimates are not (inexpensive) approximations of the Goldberger results.

In deriving the variance of errors in the forecast, we need to consider two sources of variation—from disturbances and from the parameter estimates. If we consider only the first source of variation, there is no problem. Both groups of researchers use identical methods.[3] However, for variation due to the parameter estimates, we find that, at least in this example, the Teigen/Bell method considerably underestimates the variances obtained using the other more conventional method. ■

[3] Thus, each diagonal element of table 2 equals the square of its corresponding postharvest standard error of estimate in Teigen/Bell's table 1.

Table 1—Upper triangle of the symmetric matrix $F\hat{B}F'$

Variable	Variable				
	FD	FO	CX	CS	PC
FD	1038600	9067·3	-1058800	11135	-488·91
FO		1620·6	-17046	6357·8	-32·741
CX			1382400	-306620	854·79
CS				289130	-333·14
PC					1·6995

Table 2—Upper triangle of the symmetric matrix, $\hat{C}$

Variable	Variable				
	V_1	V_2	V_3	V_4	V_5
V_1	7235·7	-163·24	-2270·5	-4801·0	3·3363
V_2		179·84	32·443	-49·043	-·14614
V_3			2876·3	-638·23	-3·9535
V_4				5489·3	·76337
V_5					J01345

In Earlier Issues

In recent years, production theory has become increasingly satisfying, not only in its structure but also in its contribution to practical daily problems. But demand theory has not been so blessed with the same progress probably because of the complexity of man as a consumer. . . . Revisions in formal consumption theory are long overdue.

Howard L. Parsons
Vol. 2, No. 4, Oct. 1950
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CONFIDENCE INTERVALS FOR CORN PRICE AND UTILIZATION FORECASTS: A REPLY

*By Lloyd D. Teigen and Thomas M. Bell**

In commenting on our note in the January issue, John Spriggs states that we did not use the Goldberger-Nagar-Odeh(GNO) variance-of-forecast estimator (*2*) and that our estimated variance of forecast is smaller than theirs.[1] [2] Spriggs is correct on both counts.

We proposed a means to bound the random variation around a "known" structure (*8*). This structure results from both econometric modeling and also the expertise of commodity specialists. To be acceptable in the context of the USDA forecasting process, the method derived had to be easily generalized to a multicommodity framework with a minimum of additional computations.

We downplayed the components of variance due to the variability of reduced-form parameters for several reasons. "To learn what variability of price and utilization is due to the variables we collapsed into the intercepts, sensitivity analysis must be performed" (*9*, pg. 26). We continue to feel that the most important element reducing parameter variance is the prior information regarding structural elasticities and appropriate system response. This information comes from commodity specialists, previously reported research, and continuous, repeated testing of the structure.

For example, assume the variance of the prior distribution-of-coefficient vector is $\sigma^2(Z'Z)^{-1}$, where σ^2 is the variance of the sample disturbances and $Z'Z$ is a positive semidefinite matrix. The precision[3] of the estimates which incorporate this information becomes $(X'X + Z'Z)/\sigma^2$, not $(X'X)\sigma^2$.[4] Namely, the estimates using prior information are more precise than ordinary least squares estimates.

Another reason for downplaying the role of coefficient variances is that Goldberger-Nagar-Odeh derive asymptotic variances, rather than finite sample variances. It is well known that the asymptotic variance, the variance of the limiting distribution, is not necessarily identical to the limit of the sequence of finite sample variances, variances which may not even exist (*9*, p. 367). McCarthy states two circumstances under which the finite sample variance of the reduced-form parameters does not exist, although he does not preclude the possibility of such variance entirely (*4*).

The third reason we downplayed coefficient variances is captured by several of the "supposes" of Goldberger:

> Suppose that consistent and asymptotically unbiased estimates of the structural coefficients have been obtained . . . suppose also that asymptotic variances and covariances of the structural coefficient estimates are available (*2*, p. 558).

Five of the six equations were estimated using OLS techniques, and the coefficient covariances were not available. The logic says, "If *a* is true,, then Goldberger." But, if *a* is not true, no conclusion follows.

In his example, Spriggs considered the question of coefficient covariances by assuming zero correlations among parameter estimates. In fact, negative parameter correlations can occur even when strong positive correlations exist among the explanatory variables.

However, the fundamental points involve the operational[5] and empirical considerations involved in placing confidence bounds on USDA forecasts. Operationally, the Goldberger procedure for this model would have required matrix operations on 6 x 6, 6 x 84, 84 x 120, and 120 x 120-dimension matrices. If this procedure were applied to the entire cross-commodity forecasting system (*7*) with 165 endogenous and 130 exogenous variables, these same matrices would be 165 x 165; 165 x 21,450 x 48,675; and 48,675 x 48,675.[6] This latter process would manipulate more than 3.4 billion elements to fill a 165 x 165 array.

Spriggs' interpretation of our $(1 + k/n)$ factor is incorrect. This adjustment is not meant as a bypass of the Goldberger calculation. It is simply a linear approximation to the curvilinear confidence band, on each relationship. This approximation simplifies the calculation process and it avoids some difficulties inherent in the process of aggregating these bands.

The adjustment evolved as a help in determining a standard error for price when all the stochastic relationships were estimated in quantity-dependent form. $(1 + k/n)$ is approximately the square root of the multiplier on the residual variance in the case of a single-equation variance of forecast when there are k orthogonal explanatory variables, each two standard deviations away from its mean.

The estimated Goldberger variances also overstate the actual errors which have occurred in recent USDA forecasts.[7] The table shows the root

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*The authors are agricultural economists in the Commodity Economics Division, ESCS.

[1] Bell (*1*) has used the Goldberger, Nager, Odeh estimator (hereafter referred to as Goldberger method) in a set of Monte Carlo experiments with the two-equation Neiswanger-Yancey (*5*) model.

[2] Italicized numbers in parentheses refer to items in References at the end of this note.

[3] The precision is defined as the inverse of the variance. See Raiffa and Schlaifer (*6*, p. 334).

[4] Explicitly, if the sample observation vector (Y) is distributed $N(XB, \dot{\sigma}^2 I)$, and the prior distribution of the parameter vector (B) is $N(\beta_O, \sigma^2 Z'Z)$, Theil's mixed estimator (*9*, p. 347ff) is $(X'X + Z'Z)^{-1}$ $(Z'\beta_O + X'Y)$. The variance of this estimator is $\sigma^2(X'X + Z'Z)^{-1}$. The rows of Z are appropriately scaled eigenvectors of covariance matrix for the prior distribution of the coefficients.

[5] The Goldberger procedure requires inversion of the matrix of coefficients of the endogenous variables for a linear system. Most USDA forecasting models are nonlinear so that the Gauss-Seidel numerical algorithm is used to generate the forecasts. In this process, algebraic expressions for reduced-form parameters cannot be obtained.

[6] The computations required by the case of stochastic exogenous variables discussed in (*3*) are, of course, not included.

[7] Bell (*1*) compares the standard deviations of the sampling distribution with root mean square errors

Errors in USDA corn forecasts, crop years 1973-76

Variable	Root mean squared errors 1973/74 to 1976/77[1]					Post harvest		1976/77 actual value
	May	Aug./ Sept.	Nov.	Feb.	All months	Goldberger standard error	Our standard error	
	Million bushels							
Production	1149.7	160.1	209.6	49.1	549.5	0	0	6357
Feed use	819.2	363.9	47.9	118.8	427.5	1023.	102.8	3587
Exports[2]	388.2	270.6	196.8	171.2	259.6	1177.	63.72	1684
Food use	23.6	21.7	22.6	15.5	20.82	43.43	16.09	493
	Dollars/bushel							
Price[3]	---	---	.297	.288	.292	1.309	1368	2.15

[1] Derived from *Feed Situation*, Econ., Statis., and Coop. Serv., U.S. Dept. Agr., various issues. The denominator used was n, not $n-1$. [2] The standard deviation of quarterly corn price forecasts for in-house USDA forecasts and those of Chase Econometrics, Data Resources, Inc., and Wharton Economic Forecasting Associates were 0.14, 0.06, 0.05, and 0.07, respectively, for 1977. These include both preharvest and postharvest information. [3] Corresponding figures for corn exports were 27, 20, 38, and 25, respectively, for 1977.

mean squared error of forecast for crop years 1973 to 1976, the Goldberger standard error, our standard error, and the actual value of the forecasted variable for 1976. One may thus infer that perhaps our standard errors somewhat underestimated the post-harvest variation, but not nearly by the extent to which the Goldberger variance overestimated them.

To assert that more than a 60-percent coefficient of variation exists on either price or exports when harvest is known seems excessive. Either Spriggs' empirical assumptions regarding the coefficient covariances excessively belie reality or the Goldberger procedure in fact says that we should place no confidence in the forecasts emanating from our models. Another alternative would be to suggest one can use a different way to arrive at the variance of forecast. Our approach has been offered as one such method.

and standard deviations calculated by the GNO technique. One can also compare structural standard errors with the final GNO estimate in Bell's study.

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A FURTHER NOTE ON THE ACCURACY OF ALGORITHMS FOR LEAST SQUARES

*By Jack Rower**

Hyman Weingarten's recent note in Agricultural Economics Research, on the accuracy of computer algorithms for least squares estimation, gives cause for several comments.[1] Weingarten derived results using two fifth-degree polynomials known to be ill-conditioned. This test procedure has been used extensively and employed widely in the literature.[2] Overall, the results were mixed for some of the ordinary least squares software employed by USDA economists; five of the algorithms tested showed completely acceptable results, given the dual-equation test standard.[3] "Speakeasy" was one of the five acceptable algorithms according to Weingarten. Speakeasy/Fedeasy is a high-level language developed by the Argonne National Laboratories.[4]

Speakeasy is widely used by USDA economists to retrieve stored data, generate reports, and perform economic analysis. (See the articles on OASIS in this issue.) Consequently, the accuracy of the Speakeasy regression algorithms deserves more attention than Weingarten gave. The algorithm he referred to is one of at least seven available in the Mu version of the Speakeasy/Fedeasy software.[5] Weingarten tested the OSLQ (ordinary least squares) algorithm. Others include BMDP1R, BMDO5R, and Speakeasy algorithms: Multireg, Simeq, Simequat, and Regression (a subcommand of Modelez in the Fedeasy component). Users can also create their own algorithms using $[X'X)^{-1}$ $(X'Y)]$ where X is the matrix of independent variable observations and Y, the vector of dependent variables.

The Speakeasy/Fedeasy algorithms have been tested by Taubman using Weingarten's technique.[6] The routines BMDP1R, BMDO5R, OLSQ, Multireg, Regression, SIMEQ, and the matrix manipulation routines produced acceptable results. The Simequat routine was the only Fedeasy algorithm that did not produce the desired result according to Taubman. Note that the Fedeasy version of BMDP1R gave a perfect fit for the two ill-conditioned cases, while the non-Fedeasy version tested gave unacceptable results. Taubman's tests were made on two different computers: IMB 7094, and Amdahl 470V6. Weingarten's work was produced on an IBM 370/168. This difference in equipment may have created some divergence in results, but probably not enough to dismiss Taubman's conclusions.

The accuracy of computerized solution techniques for ordinary least squares, or more generally, the accuracy of computerized routines in economic research, implies that some standard reference format such as footnoting or bibliographic reference is needed for algorithms used in empirical research. The large inventory of already existing computer software supports such an idea. Test results for the 21 ordinary least squares routines discussed by Weingarten show that accuracy may vary substantially within this subset. If economists are to continue to emulate the physical sciences' research methodology, they should provide sufficient information to allow others to reconstruct their "experiments" and to try to reproduce the conclusions of those experiments. As computerized algorithms vary in quality of results produced, it appears sensible to require reference to the source of such results. ■

*The author is an economist in the Foreign Demand and Competition Division, ESCS.

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SEMINARS ON FOOD POLICY IV

Reported by Thomas A. Stucker and William T. Boehm

"The Relationship Between Food Programs and the Food System" was the topic at the fourth session in the Food Policy Seminar series sponsored by the Economics, Statistics, and Cooperatives Service (ESCS). John Lee, Director of the National Economic Analysis Division, chaired the February 14 session.

In the lead paper, Ken Robinson, professor of agricultural economics at Cornell University, addressed the question of which topics should be on the research agenda and which should be on the policy agenda. He based his remarks on two premises: (1) the principal role of a policy oriented research organization is to provide information to policymakers for improved prediction of policy or program results, and (2) research priorities should be based on a preliminary assessment of the relative impact of proposed policy changes on farm incomes, food costs, and nutrition.

It has become fashionable to argue for subordination of farm policy goals to "food policies," Robinson said. However, the Congress did not design the Food and Agriculture Act of 1977 around nutritional considerations. After listing some current food policy issues as examples, Robinson stated the basic thrust of his argument: food policy analysts would be remiss if they confined their research to possible changes on the demand side. He felt that the cost of food and the diets of consumers will be influenced more by changes in farm policies which affect supply, at least over the next 4 or 5 years, than by changes in food policies which affect demand.

Citing examples such as meat import restrictions and price support levels for grains, Robinson concluded that most dietary changes are dictated by conditions of supply. "What we consume depends on what we choose to produce."

Robinson would like to see the research agenda broadened to include analysis of the consumer cost and nutritional impact of changes in farm policies as well as the effects of changes in food subsidy programs,

regulations, restrictions on advertising, and increased funding for nutritional education. Broadening the agenda could help to integrate farm, food, and nutrition policies.

Paul Nelson and John Perrin, ESCS agricultural economists, reported on some economic effects of the Food Stamp Program (FSP), using two input-output models, one regional and the other national. They estimated that the Nation's economy gained a net $2.3 billion in business receipts because of the $5.3 billion bonus Food Stamp Program, with impact varying among States. Business receipts in both the food sector and in the entire economy rise more with a purchase requirement than without one, they found. However, increases in food prices cannot be directly attributed to food stamp expenditures.

In "Commodity Distribution Programs and the Support of Farm Income," William Boehm, Thomas Stucker, Mike Belongia, and Tony Gallo, ESCS agricultural economists, found that questions remain as to whether commodity purchase and distribution programs ultimately influence farm incomes in total and over the long run. They reviewed the major legislative statements since 1935 which authorize Government commodity purchase and distribution programs, and they explained the conceptual framework for addressing the issue. A key aspect of the commodity distribution issue is whether such programs result in *net* increases in consumption. Such a gain occurs only if commodity aid is not substituted for purchased food. These programs do expand the market for farm products, the author stated, but the gains to farmers are relatively small because the programs are relatively small.

Ron Schrimper, agricultural economist at North Carolina State University, estimated the price effects of food programs in his paper: "Food Programs and the Retail Price of Food." He proposed a model for price analysis to consider effects of changes in demand induced by the Federal food programs. Schrimper found that the programs tend to increase retail food prices only slightly. An accurate empirical estimate, he pointed out, depends on estimates of the price elasticity of demand and of supply for food at retail. ■

SEMINARS ON FOOD POLICY V

*Reported by Thomas A. Stucker and William T. Boehm**

At the final food policy seminar in the series sponsored by the Economics, Statistics, and Cooperatives Service, speakers addressed the topic of efficiency and effectiveness in food program operations. Lewis Straus, Administrator of USDA's Food and Nutrition Service (FNS), moderated the seminar, held March 14, 1978.

Stephen Hiemstra, Director of Economic Analysis and Program Evaluation in FNS, led off by speaking about research on the efficiency and effectiveness of USDA's food assistance programs. Program effectiveness is measured, he said, by comparing results with program objectives. The efficient program is one in which clientele are being served the best way possible, given the budget constraints.

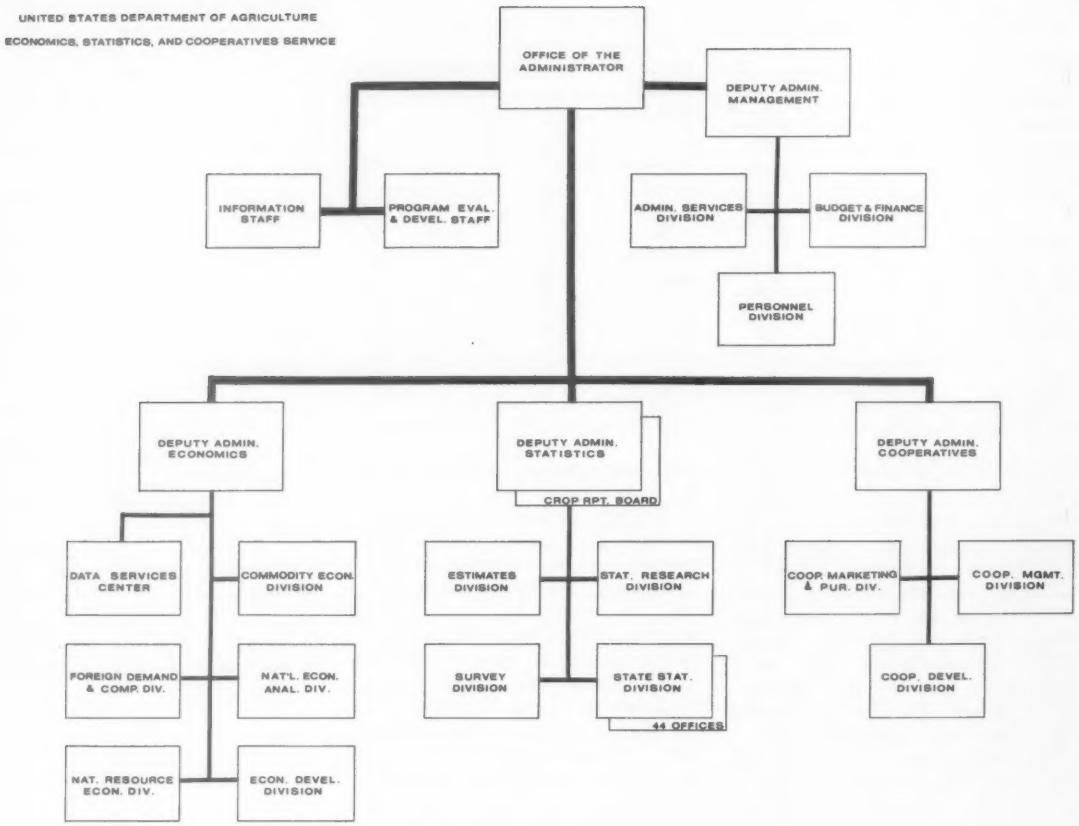
Program evaluation, he stated, includes: clarification of objectives, specification of evaluation criteria, and choice of statistical and analytical methodology. Research or evaluation is difficult for several reasons. Objectives change with new legislation. Some benefits and costs are not easily measured. Secondary data are often accepted and used when primary data are needed. Variations in time and place are not examined through use of annual, national data. Researchers do not fully understand household spending habits nor does anyone know enough about what constitutes a proper diet. Programs result in income transfers which are not stated objectives of the authorizing legislation. Hiemstra concluded that consumer demand controls the market in the long run and that food programs appear to more effective and efficient than some observers have said.

*The reporters are agricultural economists in the National Economic Analysis Division, ESCS.

Donald West, associate professor of agricultural economics, Washington University (on leave with USDA's Food and Nutrition Service) reviewed the experience with program evaluation in the State of Washington. Findings on participation in USDA's National School Lunch Program were presented by Walter Epps, an ESCS agricultural economist. An ESCS research paper describing the process of food stamp use and redemption was presented by Masao Matsumoto.

G. William Hoagland, policy analyst in the Congressional Budget Office, described the impact of the new Congressional budget process on food and nutrition policymaking. He saw the budget process as helping to effect intelligent tradeoffs among Federal programs. New and needed food and nutrition programs will be carefully scrutinized by the Congress, he said, thus challenging researchers and policymakers to outline carefully food and nutrition objectives and the alternative mechanisms for reaching them.

Reviews of Food Policy Seminars I, II, and III appeared in the April 1978 issue of *Agricultural Economics Research*. The full proceedings will be published in a forthcoming issue of *Agricultural-Food Policy Review*. ■



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